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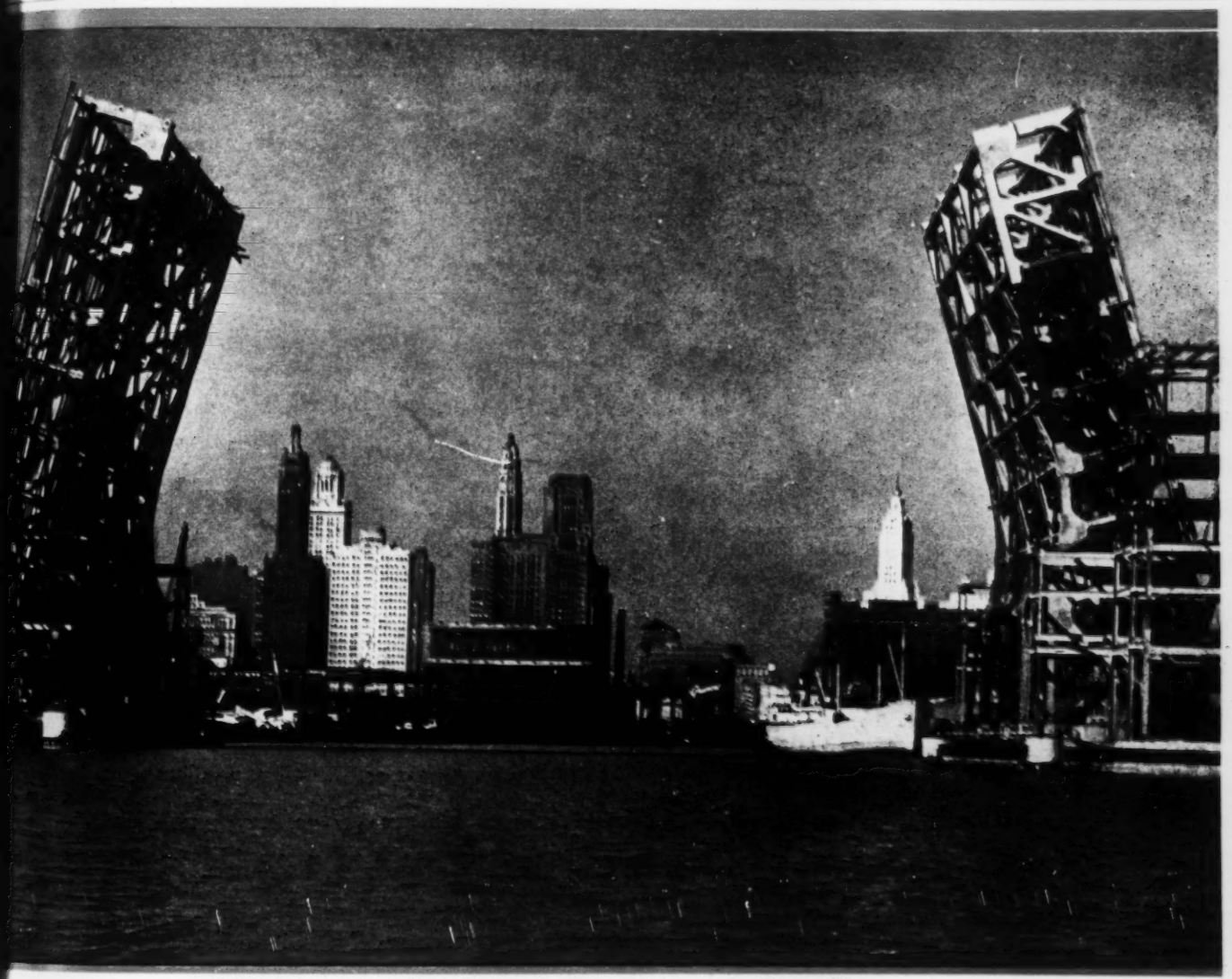

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Conchas Dam and Reservoir Project . . . Lakefront Boulevard Link at Chicago . . . Census of the Contracting Business . . . Getting Rid of Zigzags in Michigan Highway System . . . Roadside Erosion Control . . . Development of a New Port at Brownsville . . . Hollow Concrete Rigid Frames . . . Changes in West Side of New York

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Saving at the Spigot to Waste at the Bunghole

A FEW DAYS ago the President stirred widespread comment by announcing an intention to divert federal spending from activities that create demand for durable goods to those that would increase demand for consumer goods. He feels that the production of durable goods now is too great in relation to that of consumer goods and that this situation is a threat to continued recovery.

Without debating that question—and there is much room for doubt as to his premise—it is evident that the President's statement was not prompted by economic considerations alone. Doubtless there entered into his calculations several other factors of greater or less political significance: the pressure for more funds for WPA work-relief; a desire to crack down on certain industries that have announced price increases as a result of new labor agreements; the pressure for new taxes on the one hand and for a balanced budget on the other. These are just a few of the matters that lurk in the scenery; the whole subject is not so simple as it sounds in the President's statement.

But, eliminating all these implications and taking what he said at its face value, it is worthwhile to enter a few notes as to his conclusions.

THE spending for durable goods that he would discontinue includes construction projects such as those of the PWA. The spending for consumable goods that he would foster includes the work relief of WPA. In short, this is the same old proposal to curtail the PWA effort in favor of increased WPA activity. All that is new is the reason advanced for it.

This page has stood consistently for the use of federal credit to sustain the capital goods industries through the trough of a depression that paralyzes private enterprise. But a necessary feature of such a policy is the reduction of the public debt thus incurred out of the earnings of recovering business. If the public debt is increased to tide over a depression it must be reduced during recovery. Thus only can the credit again be available for the next cycle.

Even some of the ardent advocates of federal spending for any purpose now are alarmed at the continued use of public credit for mere spending and are urging the sounder but less politically popular course of raising revenues by higher taxes. But the more conservative of those who advocated federal investment during depression now demand that the government not only cease spending on credit but also begin to apply its tax revenues to the retirement of the present debt. That is the course of wisdom; it is the natural and essential sequel to the public works investment of the depression.

To curtail such investment for that purpose may be justified; but it will not help the economic picture to curtail investment in useful facilities simply so that we may continue the inflation of federal credit through spending on work-relief of doubtful value.

ANOTHER unfortunate aspect of the President's broad statement is his failure to discriminate between emergency expenditures to stimulate the capital goods industries and the regular investment of federal funds in useful and necessary public works. It is slightly more than two months since the President himself urged upon Congress a six-year program of more than $5,000,000,000 to "provide needed facilities for our people." This, of course, is in addition to other needed facilities that are normally built by cities, states and other local units.

The President's statement should not be interpreted to mean that useful public works now should be shelved in order that Harry Hopkins may have more funds for his favorite pastime of putting every American on a public payroll whether or not he is able or willing to work and whether or not the government has the income to pay his wages. Yet that is the construction that will be put upon it by many who have come to think of all public works construction as a new stunt that has just been invented to make jobs for those who cannot or will not work except for the government.

Willard Chevalier

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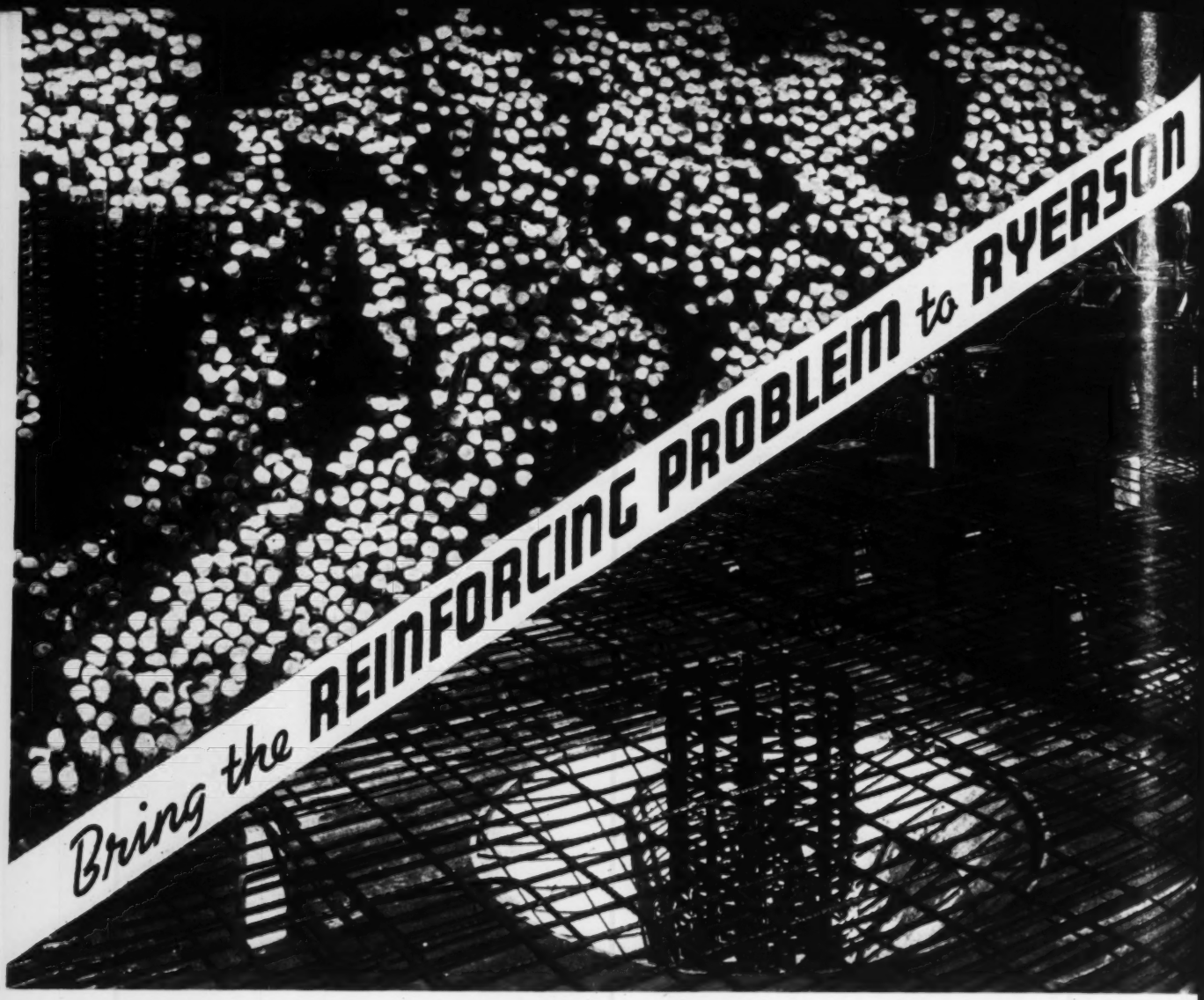

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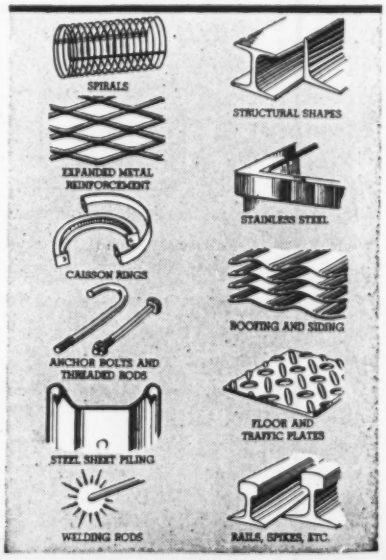

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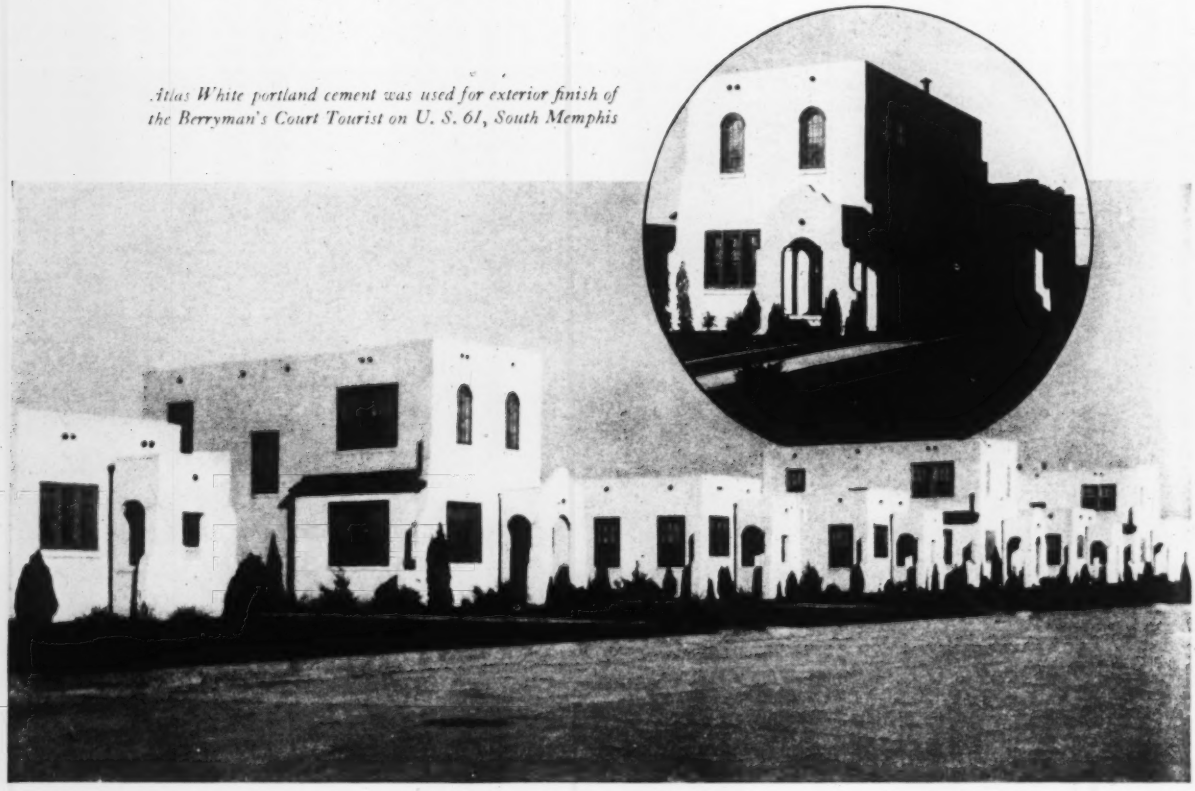
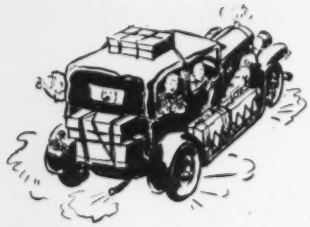
Railway Construction Again— Building of new rail lines dwindled to negligible quantities following 1929, but last year the Santa Fe built 110 miles to complete a new short route to the Gulf. The new line will be described in next week's issue. It is noteworthy for rapidity of construction and the mechanization of construction operations, also for the effect that recent increases in train speeds have had on its design.

Atlas White portland cement was used for exterior finish of the Berryman's Court Tourist on U. S. 61, South Memphis





"Yes, by Gosh, it's a Tourist Camp!"

● Tourists motoring along U. S. Highway 61, South Memphis, are always amazed at the unique Berryman's Court Tourist. For this is probably the last word in what nomads of the highways call "tourist camps."

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FIG. 1—CONCHAS DAMSITE looking downstream. The cement handling equipment on right. Note upper rock cap on which the overbank concrete monoliths will be founded.

Conchas Dam and Reservoir Project

Work begun on combined flood control and irrigation water storage project on South Canadian River in New Mexico after extensive study of stream flows and of possible dam sites—Dam adapted to peculiar rock condition in river gorge.

By John R. Noyes
Captain, Corps of Engineers, U. S. Army, Conchas Dam, N. M.

AUTHORIZED for construction under the Emergency Relief Appropriation Act of 1935, the Conchas Dam is being built to provide employment and to regulate and utilize the flood waters of the South Canadian River, a tributary of the Arkansas. An initial allotment of $2,280,000 was provided for the work and on Aug. 1, 1935 a district office of the U. S. Engineer Department was established in Tucumcari, N. M. Work got under way promptly upon preliminary operations connected with the project, such as preparing a means of access and a temporary construction camp and initiating extensive surveys, investigations and studies preparatory to the design of the permanent structures. This article has to do with the early work and the design basis of the dam.

Rising in the Rocky Mountains in northern New Mexico, the South Canadian River flows southward 150 mi. to the vicinity of Tucumcari and thence eastward 550 mi. across New Mexico, Texas and Oklahoma to the vicinity of Eufaula, Okla., where it is joined by the North Canadian and continues eastward to its junction with the Arkansas near Muskogee. Its basin is pear-shaped—wide and steep near the headwaters and narrow and flat in the lower reaches, so that 51 per cent of the watershed and all of the major tributaries lie in New Mexico. The headwaters rise amidst peaks 12,000 to 13,000 ft. high having an annual precipitation of 26 in., a considerable part of which falls as snow. The intermediate course, on the other hand, lies in semi-arid country having an annual precipitation of less than 15 in., much of which occurs during the summer in the form of torrential downpours, which produce flash floods of great magnitude. The lower course, in Texas and Oklahoma, lies in moderately rolling plains country which becomes progressively more humid eastward as the Mississippi Valley is approached. The intensity of the storms, the steep and rocky slopes of the tributaries and the funnel-shaped drainage area all combine to accentuate floods in the upper portions of the watershed, which pass rapidly downstream and cause great damage throughout the lower course of the river.

Flood control of the South Canadian River was investigated as a part of the nation-wide "308" studies made by the War Department from 1927 to 1932. The investigation resulted in the formulation of a feasible plan for the construction of a flood-control dam a short distance below the mouth of the Conchas River, an important western tributary. This plan combined the advantages of flood control with the possibility of use of impounded water for irrigation. The site lies 30 mi. northwest of Tucumcari at a point where the course of the river turns generally eastward and near the point where it issues from a dissected plateau region adjacent to the mountains into the great plains. Areas suitable for irrigation are found in the plains near Tucumcari.

To carry out the purposes of the Emergency Relief Act, immediate utilization of local labor was accomplished by the construction of a 27-mi. road to the damsite. Provision of a means of access was followed by construction of a camp near the site. Both of these

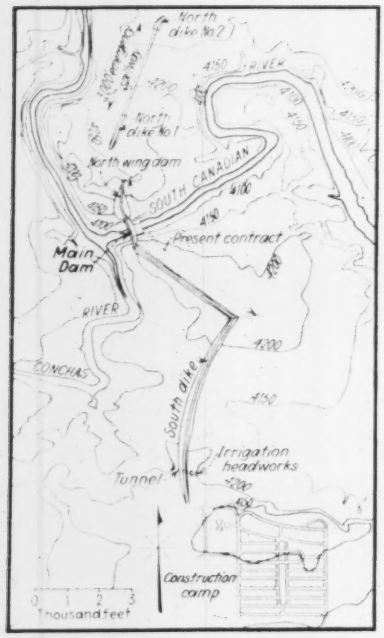


FIG. 2—THE MAIN DAM across the South Canadian River below the mouth of Conchas River is to be flanked by a long wing dam and dikes across low saddles.

operations were by hired labor obtained from relief offices in New Mexico and Texas. Increase in employment was carefully regulated so that no layoffs were necessary due to lack of work on the preliminary operations. At the same time the necessity of providing housing, food and water at the site, where everything had to be improvised, required careful coordination of employment with facilities. The peak of relief employment, 2,426, was reached in June, 1936. A total of 1,100 man-years of direct labor was provided between Aug. 1, 1935 and Sept. 15, 1936, at a cost of $1,650 per man-year.

Adobe houses

Plans and specifications for the construction road and camp were prepared in Tucumcari and reviewed in the office of the division engineer, Lower Mississippi Valley Division, Vicksburg, Miss. The road was constructed with a base of native "caliche" and a surface of gravel. The camp was constructed of native adobe and stone materials, which conformed with local practice, and produced an attractive, comfortable and fireproof camp at a cost very little in excess of that required for adequate wooden or composition buildings of conventional type. This selection was particularly fortunate in that it conformed to the habits and capabilities of the local labor, an important consideration, since persons having a knowledge of masonry construction were readily obtainable from relief rolls and could be utilized without extensive training.

All materials for the camp excepting adobe bricks and stone had to be procured from distant points, shipped by rail to Newkirk, N. M., and trucked 25 mi. to the camp site over the partly completed road. In addition to camp buildings and water and sewer systems, electric light and power and communication services for a population of 2,000 were provided. Owing to the isolation of the community all labor employed on the project lives in the camp or occupies improvised shelter nearby.

Adobe bricks were made near the construction camp by the traditional hand process. For this purpose an area of 16 acres of suitable sand-clay loam was set aside for adobe fabrication. This was plowed and harrowed, water and straw added, and this mixture converted into mud by laborers with hoes and shovels. Then the mud was fashioned into blocks 12 in. square by 4 in. thick in hand molds. The blocks were sun-dried for about one week (longer in cold weather) before use. As freezing temperatures prevent the proper curing of the adobe, fabrication had to be suspended in winter. During cold weather a part of the camp was constructed of local sandstone, but the stone buildings, while attractive in appearance, are neither as economical nor as comfortable as the adobe structures.

Utilities

Utilities provided at the camp include water supply, gas, electricity and sewerage. As no large commercial source of electric power is available within many miles of Conchas Dam all such power is generated locally. Natural gas from the Texas oil fields is supplied through a 6-in. pipeline from Tucumcari; a complete distribution system permits the use of gas for all domestic purposes as well as for the generation of electricity. For the latter purpose a powerhouse has been constructed which when completed will contain six 285-kw. gas-engine generating units. The domestic load, largely for lighting purposes, is 200 kw. The construction load may amount to as much as 1,830 kw. of connected capacity, the use of which will be carefully regulated.

Water supply

Provision of a suitable and adequate water supply for domestic and construction purposes was a serious problem. In the semi-arid country no surface water normally exists except water in the South Canadian River, which is hard, heavily silt-laden and incapable of use without treatment. Owing to the expense of developing a water supply from the river, efforts were made to locate an underground supply, but geological investigation supplemented by well drilling indicated that the deeper underground waters are excessively saline while the shallower underground supplies are limited in quantity. Accordingly it became necessary to develop the river supply. A temporary sheetpile and rockfill detention dam creates a pool about 3 mi. long in the South Canadian River just above the mouth of the Conchas, from which water is pumped to a treatment plant at the camp through an 8-in. spiral-welded steel pipeline 14,140 ft. long. Treatment is effected by chlorination and dosing with alum and activated carbon, which precipitates the silt and renders the water potable, though without removing the hardness. After settling, the water so treated is pumped into the system. Provision is made for more than 10,000,000 gal. of storage in tanks to guard against the possibility of water shortage, while the pumps are provided with both gasoline and electric drive to guard against power failure and the intake structures are made retractible to prevent the possibility of damage by large floods.

By the end of 1936 the construction camp was complete and all activities

FIG. 3—ADOBE CONSTRUCTION CAMP for Conchas Dam project with water treatment plant, large steel storage tanks and small elevated storage tank.

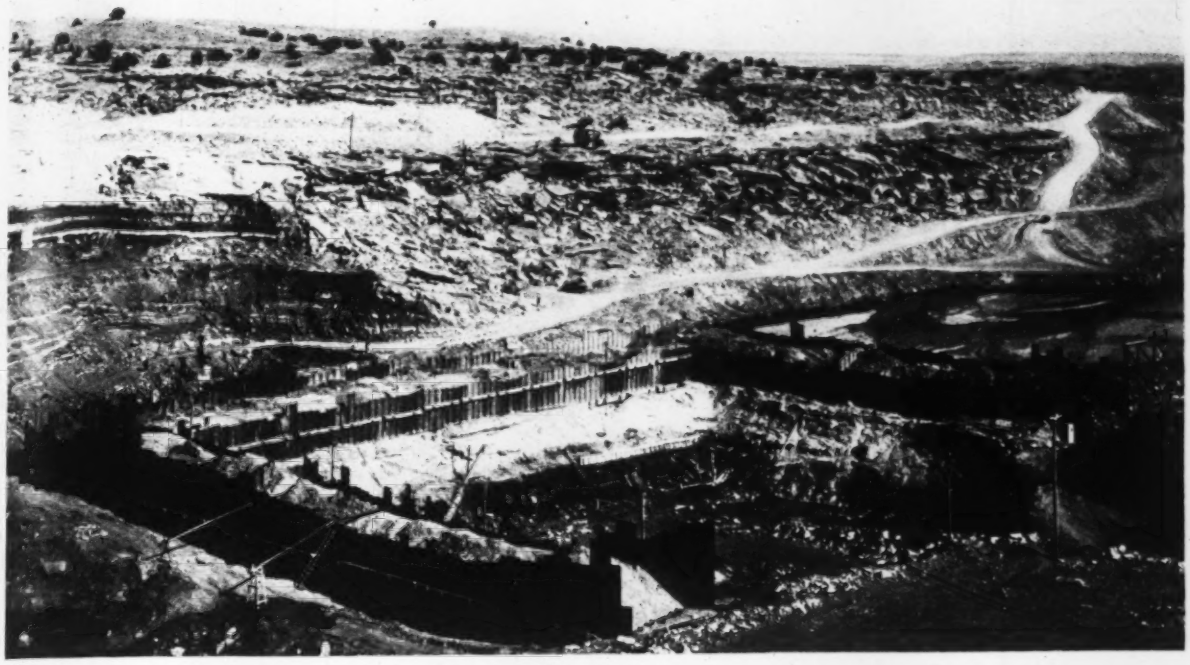


FIG. 4—COFFERDAM for north portion of central concrete monolith of Conchas Dam.

of the district were transferred to the camp from Tucumcari. The camp is operated by the government. Housing is provided for 138 families, and dormitories for 1,500 single employees, this including all forces of the contractor as well as those of the government. A single large mess with modern gas-fired equipment feeds all single employees for a charge of $25 per man-month. Business concessions have been let for grocery store, restaurant, drug store, barber shop and other essential enterprises, while amusement is provided by a moving picture house, a billiard parlor and an active employees' recreation association. A school with a present enrollment of 80 pupils, a church, post office "Conchas Dam," and telephone and telegraph services are available. All of these installations, rendered necessary by the isolation of the project, came into being in the first year of work.

With the accomplishment of the first objective, that of providing immediate and adequate work relief, the project passed into its second stage. With the provision of an allotment of $3,500,000 from the War Department Appropriation Act of 1936, operations definitely passed from a work-relief basis to a regular construction basis. The engineering studies necessary to prepare for the construction had at that time already been essentially completed.

Hydrology

Shortly after the commencement of work on the project the collection and evaluation of all available streamflow, precipitation and other pertinent data was started. The most important questions to be answered by these studies before the design of the structure could be undertaken were the magnitude of the probable maximum flood and the annual net yield of the watershed above the damsite. Existing hydrologic records were very deficient. The irregular nature of precipitation and runoff in the watershed rendered its forecasting a difficult problem, and to supplement the available data recourse was had for comparative study to precipitation records for Colorado, Kansas, Oklahoma, Texas and New Mexico as well as to runoff records of the South Canadian, Pecos, Rio Grande and neighboring river basins.

The longest continuous precipitation record at any one station available for the South Canadian watershed above Conchas Dam was 36 yr. A number of records of 25yr. or less exist, but many of these are seriously incomplete. All in all, 129 precipitation records in the South Canadian and neighboring watersheds were utilized for study. Runoff records were even more fragmentary. The records of 47 streamflow stations, of which 36 were in the South Canadian basin, were considered, but only two or three of these were sufficiently continuous to be susceptible of use in their entirety and most of them were valuable mainly from a qualitative standpoint. Hydrographs prior to 1929 were constructed by rational methods from pertinent data involving the evaluation of a number of incomplete records; these were interpreted in the light of the more recent hydrographs which could be prepared from more adequate data.

Studies of large floods using all available records made possible the development of a hydrograph for the maximum probable flood at the damsite. This flood, it was computed, would produce a total volume of 1,117,000 acre-ft. of water in 3 days, possibly augmented by an additional 60,000 acre-ft. by the failure of small upstream reservoirs. The hydrograph was shaped to conform to the maximum flood of record, that of Sept. 26-30, 1904, which produced 836,800 acre-ft. with a peak flow of 279,000 sec.-ft. at the damsite. The maximum probable flood was computed on this basis to produce a peak flow of 582,000 sec.-ft. The sudden rise and high instantaneous rate of discharge for a given volume are characteristic of floods of the South Canadian River.

For the evaluation of the average annual flow, a 32-yr. hydrograph was constructed from actual records where available and comparative studies in the absence of records. Precipitation records, evaporation, snow studies and the effect of upstream irrigation use were taken into account in the adjustment of streamflow data. From the 32-yr. hydrograph a gross average annual yield in the neighborhood of 212,000 acre-ft. at the damsite was predicted, not all of which could be made available—due to evaporation and seepage losses in the reservoir and unavoidable waste during large floods. In computing this average annual yield the 1904 flood was taken into account. However, this flood was so unusual that a more reasonable value was ob-

tained when it was excluded from the computations. It is probable that from 160,000 to 180,000 acre-ft. per year more nearly represents the gross average annual yield that can be depended upon. The net yield available for irrigation purposes is computed to be from 140,000 to 150,000 acre-ft. per year, with the 1904 flood excluded.

While the hydrologic studies were in progress, detailed topographic surveys were made of the reservoir area to a scale of 1:10,000 and of the most probable locations for the damsite to a scale of 100 ft. to 1 in. Some 85 planetable sheets to these scales were prepared. Geologic investigations including an extensive core-drilling program were conducted simultaneously. Three alternative locations for the main dam were considered. The site selected lies across the South Canadian River 1,150 ft. downstream from the mouth of the Conchas, the basin of which provides the bulk of the storage capacity necessary for the reservoir. Above this point the South Canadian flows through a canyon of some depth, so that a high dam clearing the canyon walls was designed in order to develop additional reservoir capacity by the use of supplementary dikes following adjacent high ground and inclosing large areas.

From these surveys and investigations and the hydrologic studies a balanced allocation of practicable reservoir capacity was determined. It was deemed impracticable to control the maximum probable flood within bankfull stages below the dam, but an allocation of 200,000 acre-ft. of reservoir capacity to flood-control detention was determined to be sufficient to control all ordinary floods within such stages and substantially to reduce the overflow of floods of greater magnitude through backwater storage above spillway level.

An allocation of 300,000 acre-ft. of reservoir capacity to irrigation storage was determined to be practicable below the flood-control pool and above the elevation necessary for a gravity irrigation outlet. This amount of storage was also determined to be required in order to provide reasonable regulation of the estimated annual net draft of 140,000 acre-ft. The elevation required by the irrigation outlet for gravity discharge was such that 100,000 acre-ft. of reservoir capacity will lie below the irrigation pool in the river canyons and will thus constitute dead storage. While not available for draft this dead storage capacity will inhibit encroachment of silt on useful storage.

This allocation of storage represents what is believed to be a workable compromise between the demands of flood control on the one hand and the needs of irrigation storage on the other. The possibility of some deficiency of irrigation yield in a series of dry years is recognized.

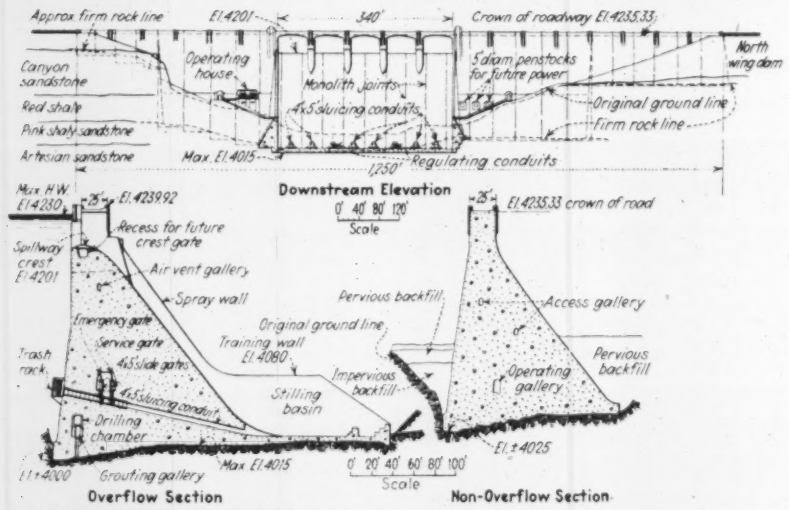


FIG. 5—THE STRUCTURE forming the main part of Conchas Dam is to be of concrete with a maximum height of 235 ft. to the roadway level. Because the shale is unsound, the canyon sides will be cut back until the flanking sections can be founded on the canyon sandstone.

Gravity dam and wing walls

Based upon these storage requirements, designs of the permanent works of the project were prepared. The principal dam, 235 ft. high in the main river canyon, has its crest at El. 4,235. This crest is prolonged to adjacent high ground by wing dams on either side, and supplemental earth dikes close off certain low saddles. The main dam, a concrete gravity structure, will contain six gate-controlled conduits, each 5 ft. high and 4 ft. wide, and two regulating conduits containing 48-in. needle valves for low-water discharge. It will also contain a water-supply outlet. Located in the main dam there is to be an uncontrolled overfall spillway 340 ft. long, with its crest at El. 4,201, to care for ordinary flood discharge. This spillway is designed to pass bankfull capacity when the reservoir level reaches El. 4,218, at which point an emergency spillway 3,000 ft. long located in the north dike comes into use.

The volume of storage contained between El. 4,201 and 4,218 represents 200,000 acre-ft. of reservoir capacity allocated to flood-control detention. The volume of storage contained between El. 4,155 and 4,201 represents 300,000 acre-ft. of reservoir capacity allocated to irrigation storage. Irrigation headworks, consisting of a tunnel and the necessary gates, will be located through a natural rock ridge 1½ mi. south of the main dam with a sill at the former elevation, which is the minimum permitting gravity irrigation draft. An additional 100,000 acre-ft. of irrigation storage can be added by the future installation of automatic crest gates on top of the spillway in the main dam, thus raising the maximum level of the irrigation pool to El. 4,210 if desired. A detailed survey for irrigation development is now under way by the U. S. Bureau of Reclamation.

Foundation

In the design of the main dam, rockfill, earthfill, stone masonry and various types of concrete structures were considered. A concrete dam was adopted for reasons of suitability, conservatism of design, safety from flood damage during construction, and reasonable cost. Undesirable abutment conditions due to the presence of shale precluded the use of an arch dam, and a straight gravity section was accordingly selected.

The main dam is 1,250 ft. long. It is to be founded principally upon a formation known locally as artesian sandstone. Examination of this rock was made by 3-in. and 8-in. core drillings and by the drilling of two 30-in. core holes which permitted visual examination to a depth of 80 ft. below river level. The dam is to extend above the canyon walls on both sides, so that the outer monoliths, of small height, will be founded upon another higher formation known locally as canyon sandstone. Both of these sandstones afford competent foundations. The latter formation is separated from the former by 90 to 100 ft. of inadequate shales and sandstones. These formations will not be used to support the dam and the abutment contact between the concrete and shale will require sealing.

The project will require the construction of 13,650 lin. ft. of wingdams and dikes which will be composed of earth embankments. This does not include the 3,000-ft. emergency spillway, which will be a concrete overfall weir. The earth dikes will reach a maximum height of nearly 90 ft. and will be composed of an impervious rolled-earth core, a previous rolled blanket and rock-fill shells on both upstream and downstream

slopes. They will be founded upon sandstones or firm shales.

Actual construction of the major permanent features is now under way. A contract for the main dam and wing dams was let on Oct. 5, 1936 to Bent Brothers, Inc., and Griffith Co. of Los Angeles, Calif. for $4,587,676. Cement will be furnished by the government. Exceptionally close bidding marked this contract, as the lowest six bids received differed by only $242,000 or less than 6 per cent of the amount of the contract. The accepted bid was $8,000 under the government estimate. The contractors are assembling construction plant for operations on the main dam and are completing the necessary excavation for foundations of the river monoliths. Concrete work began in March. Design of the dikes and other structures is in progress and it is anticipated that future contracts will be advertised for the construction of these features.

The Conchas Dam and Reservoir Project is estimated to cost $12,280,000 and is scheduled for completion in 1939. New Mexico is to provide all right-of-way necessary to the project, assume responsibility for all damages and take over the operation and maintenance of the structures when completed. The work is being conducted under the supervision of Capt. Hans Kramer, Corps of Engineers, U. S. Army, district engineer. Capt. James H. Stratton, Corps of Engineers, engineering chief, is in charge of design, inspection and government hired-labor operations, assisted by J. B. Alexander, planning chief and H. V. Pittman, construction chief. Contract construction operations are under the supervision of L. T. Grider, general superintendent, for Bent Bros., Inc. and Griffith Co. First Lt. L. H. Foote, Corps of Engineers, is camp manager, while the writer is executive and disbursing officer of the district. The work is under the general supervision of Brig. Gen. H. B. Ferguson.

New Construction Transforms New York City's West Side

GREAT and significant changes are occurring in the West Side, midtown area of New York City as a result of many million dollars of expenditures for the permanent improvements indicated on the accompanying view.

The tracks of New York Central R.R. that have occupied 11th Ave. for 80 years will be placed in a new depressed right of way; some 30 bridges carry streets across this cut. Work is beginning on the second tube of the Midtown vehicular tunnel to New Jersey, and the first tube will be placed in use this year. At the right of the view is shown the new depressed street between 34th and 42nd Sts., that will serve as the tunnel approach. Both the tunnel approach and the railroad cut have effectively eliminated many slum buildings in the once notorious Hell's Kitchen district.

On the river front, the new superliner piers have been in service about a year, and opposite them the last remaining link in the elevated highway has just been opened to traffic. The city's new 750-ton incinerator is burning refuse and will be developing power by the end of the year; next door, construction operations continue on a huge department of sanitation garage. Finally, this whole area has been effectively rezoned to provide a proper balance between apartments and industry, thus promising orderly development.

Aerial Explorations Photo

Lakefront Boulevard Link Forms Milestone in Chicago Plan

Joining of park systems on north and south sides of Chicago River by a bridge and viaduct completes long-planned continuity of lakefront facilities

By Hugh E. Young

Chief Engineer, Chicago Plan Commission
Chicago, Ill.

TODAY IN CHICAGO, work is progressing rapidly on a public improvement destined to have an effect on the city's future development far greater than the eleven and one half million dollar expenditure that is being made would of itself signify. The improvement consists of a bridge across the mouth of the Chicago River and lengthy viaduct approaches that give final continuity to the lakefront boulevard system developed over the years to connect the north and south side parks. By this improvement one step more is taken to relieve Michigan Ave. traffic congestion and to provide additional area for business expansion east of the avenue. A brief survey covering the history of the project and its importance to the basic Chicago Plan will make this clear.

In the language of the day, the location of Chicago upon the shore of a great inland sea is a "natural", and it is not surprising that the lake front is one of the city's most attractive features. What is surprising is that it should have taken half of Chicago's whole corporate lifetime for its people to rise to a real appreciation of the asset they possess in this great gift of Mother Nature.

So little, indeed, did the early residents of Chicago value the lake shore that they practically threw a part of it away. In 1852, the city authorities compelled a railroad company wishing to enter the city to build its roadbed along some five to six miles of lake front. True, this was done as a measure of temporary expediency and economy on the city's part, but the result was that for more than sixty years the people were shut off from this entire length of shoreline which rightfully was theirs.

Then after the great Chicago fire of 1871 had laid low a large part of the central portion of the city, the easiest, cheapest and quickest way to dispose of the debris seemed to be to throw it into the lake. Fortunately, however, in thus taking the line of least resistance in disposing of the rubbish, the people did better than they realized at the time, for this material formed the nucleus of the area of made land which afterwards became Grant Park, and which now borders "The Loop," as Chicago's central business district is commonly known.

Park needs recognized early

Even before the beginnings of Grant Park—sometime in the early 1860's—forward looking citizens were already alive to the need for additional park area in Chicago, and as a result of their activities two lake front parks came into being. One was Lincoln Park, extending for about a mile along the city's northern shoreline. The other was Jackson Park, extending for about the same distance along the southern shoreline south of the section of lake shore occupied since 1852 by the railroad previously mentioned.

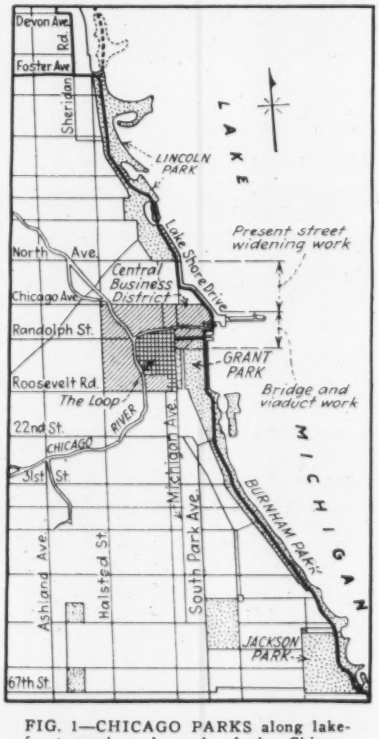


FIG. 1—CHICAGO PARKS along lakefront north and south of the Chicago River are being joined by the Outer Drive Bridge which is currently under construction.

When, in 1908, the Plan of Chicago was being developed under the auspices of the Commercial Club of Chicago, those who worked out the details of this plan thought that the three widely separated lake front parks—Lincoln, Grant and Jackson—were not enough. In their opinion the whole lake front was the rightful heritage of the people of the city. Consequently, the Plan of Chicago proposed the reclamation of virtually every foot of shoreline for public use, health and pleasure.

Step by step and year after year, under the leadership of the Chicago Plan Commission, the people of the community conducted a campaign to reclaim the lakeshore for the public until today, out of a total length of some 25 miles of shore, about fifteen are publically owned and the effort to acquire the other ten continues. Today Lincoln Park is three times as large as it was originally. Grant Park has been increased in size, and a new park—Burnham Park, extending the entire five-mile distance between Grant Park and Jackson Park—has been constructed by filling in the shallow waters along the edge of the lake (Fig. 1). These developments took place at a time when two park boards had jurisdiction: the Commissioners of Lincoln Park and the South Park Commissioners.

Bridging the river gap

Even with the general lake front plan thus far advanced, there still remained a gap in the continuity of the proposed lakefront park and boulevard development, largely due to the fact that jurisdiction over the lakeshore was divided between these two park districts. The southern boundary of the one district and the northern boundary of the other district coincided at the center line of the main channel of the Chicago River. Neither district alone could bridge the gap.

Finally, in the Fall of 1926 the Chicago Plan Commission set itself to

Chicago Aerial Survey Photo.

FIG. 2—PRESENT STATE OF CONSTRUCTION on Outer Drive link, which is carried across mouth of Chicago River on a double-leaf bascule. Upstream is the existing Michigan Ave. Bridge. The paved viaduct at the left, an extension of Randolph St., connects the Outer Drive with the Loop business district.

work out a plan for connecting the north side lakefront park and boulevard developments with those on the south side. A special committee was formed, and to the author of this article, as chief engineer of the commission, was entrusted the task of developing plans, designs and estimates of cost for an adequate and proper connection between the two park systems. Eight months' effort was devoted to preparing and considering the comparative merits of seven alternate plans for constructing such a connection, which went under the name of the Outer Drive Improvement. These plans included a tunnel, a fixed high-level bridge, and a bascule structure. The plans also proposed a number of different locations at which the Chicago River might be crossed.

In June, 1927, one of these seven plans was selected by the Chicago Plan Commission as representing the best solution of the problem. Subsequently this plan was approved by all parties in interest, and it is the plan (Fig. 3) under which the Outer Drive bridges and approaches are now being built. Land purchases, easements and other legal maters took two years' time; but by July, 1929, a contract for the bascule bridge design was let, this being followed by contracts for other portions of the work involved.

The structural features of this Outer Drive improvement will be described in detail in subsequent articles so that the briefest possible summary of the project will suffice here. The primary function of the improvement is, of course, to form the final link in what will eventually become the most important north-and-south traffic route in all Chicago: a lakefront thoroughfare, extending along the entire eastern edge of Chicago and making suitable connection with all the more important east-and-west streets in the city.

Such a route will greatly facilitate traffic movement between the north and south sides of the city, and between each of these sections and the central business district. It will serve as a by-pass whereby the congestion of the central business district and other crowded districts may be avoided. According to early estimates, the new link was expected to attract some 40,000 vehicles per day, and the increase in vehicular traffic which has taken place in the last year or two makes this figure appear truly conservative. Certain it is that present congestion on Michigan Ave., the city's only nearby parallel route, will be substantially relieved when the outer drive is opened, and that traffic flow in general will be both eased and stimulated.

New business area added

The Outer Drive improvement leads through a poorly developed section adjacent to the loop and its completion will mark the first step in the rehabilitation of this district, which now constitutes a blot upon the otherwise consistently improving development of downtown Chicago. Specifically connected with the outer drive improvement are a number of collateral street improvements (Fig. 3). The two principal ones are the 128-ft.-wide Randolph St. viaduct, now under construction, and the proposed 112-ft.-wide extension of Wacker Drive along the south bank of the river; all designs have been worked out for the latter, the city council has passed an ordinance covering the acquisition of the needed right-of-way, but no means of financing has yet been provided. Both of these new streets will extend east from Michigan Ave. to connect with the new outer drive boulevard. Within the confines of these four streets is an area of about 85 acres now devoted almost exclusively to railroad uses. It is susceptible of being improved with the best kind of building development, comparable to that of the Loop itself, and not unlike that which has taken place around the Grand Central Terminal in New York City.

Although progress in carrying out the Outer Drive improvement was delayed for several years, because of the depression and the financial difficulties arising from it, construction work has now been resumed and is being vigorously pushed. Not only have the means been found to complete the project, but the recent consolidation of the several former park districts into the new Chicago Park District has simplified the situation by concentrating all park rights and powers in a single authority.

The present improvement

As shown on Figs. 2 and 3, the Outer Drive improvement extends Lake Shore Drive south from its present terminus at Ohio St. It rises from that point on a filled approach 139 ft. wide, extending from Ohio St. to Grand Ave. Thence it extends south on a viaduct 139 ft. wide, over the lands of the Chicago Dock & Canal Co. to the Michigan Canal, crossing this canal on a single-leaf, four-truss bascule bridge 108 ft. wide; thence south on viaduct construction to the Chicago River, which it crosses, on a two-leaf four-truss bascule bridge 108 ft. wide and having a clear channel for navigation of 220 ft. This bridge will be monumental in character, and there will be large plazas on each approach constructed of granite and Bedford stone. The south plaza is designed so that at some future time the Outer Drive can be extended due south to Randolph St.

West from the south plaza the drive is carried on a viaduct 140 ft. wide, extending along the south bank of the Chicago River to the north-and-south line of the Outer Drive in Grant Park, known as Field Boulevard. This section of the improvement will become a part of the future extension of Wacker Drive.

Turning south again the improvement follows the line of the park drive (which is in line with the north-and-south axis of the Field Museum), over the railroad yards of the Illinois Central Railroad on a viaduct structure 140 ft. wide, to Randolph St.—the northern boundary of Grant Park—where it connects with both Randolph St. and the present Outer Drive (Field Boulevard) in Grant Park.

The two 38-ft. roadways on the bridges will accommodate four lanes of moving traffic in each direction. At the ends of the river bridge large oval-shaped plazas will be provided, giving ample capacity for the turning of vehicles and space for temporary storage while the bridge is open. The approaches to the two bridges will have a 100-ft. roadway, curb to curb, which will provide for two parking lanes and eight lanes of moving traffic.

At the north end of the improvement, at Ohio St., the 100-ft. roadway will connect with the present 50-ft. roadway on Lake Shore Drive. It is expected, however, that in the near future the 30-ft. roadway on Ohio St. will be widened to 56 ft. Work already is underway on the widening of Lake Shore Drive to provide two 50-ft. roadways.

At the south end of the improvement at Randolph St., the 100-ft. roadway terminates in a large plaza formed by the intersection of these streets, and at Monroe St. connects with Field Boulevard in Grant Park which has a 72-ft. roadway. Randolph St., the feeder from the loop, will be 80-ft. wide.

Economic justification

Computations based (1) on a traffic flow of 40,000 vehicles per day (2) on a saving of eight minutes between Oak St. and Seventh St., made possible by the use of the Outer Drive instead of Michigan Ave. and (3) on a delay cost estimated to be one cent per car per minute show that the saving in vehicle operation should amount to $584,000 per annum, which, capitalized at 5 per cent, would indicate that $23,360,000 could properly be expended to eliminate this delay. The total estimated cost of the Outer Drive improvement amounts to $11,563,000. It is plain, therefore, that the project is economically sound.

The estimated saving in time that will be possible when the Outer Drive is completed, over the time now required to travel the same distance on Michigan Ave. is based on an assumed average speed of 30 miles per hour on the Outer Drive, as against the average of 15 miles per hour on Michigan Ave. during non-rush hours and 8 miles per hour during rush hours.

Future extensions

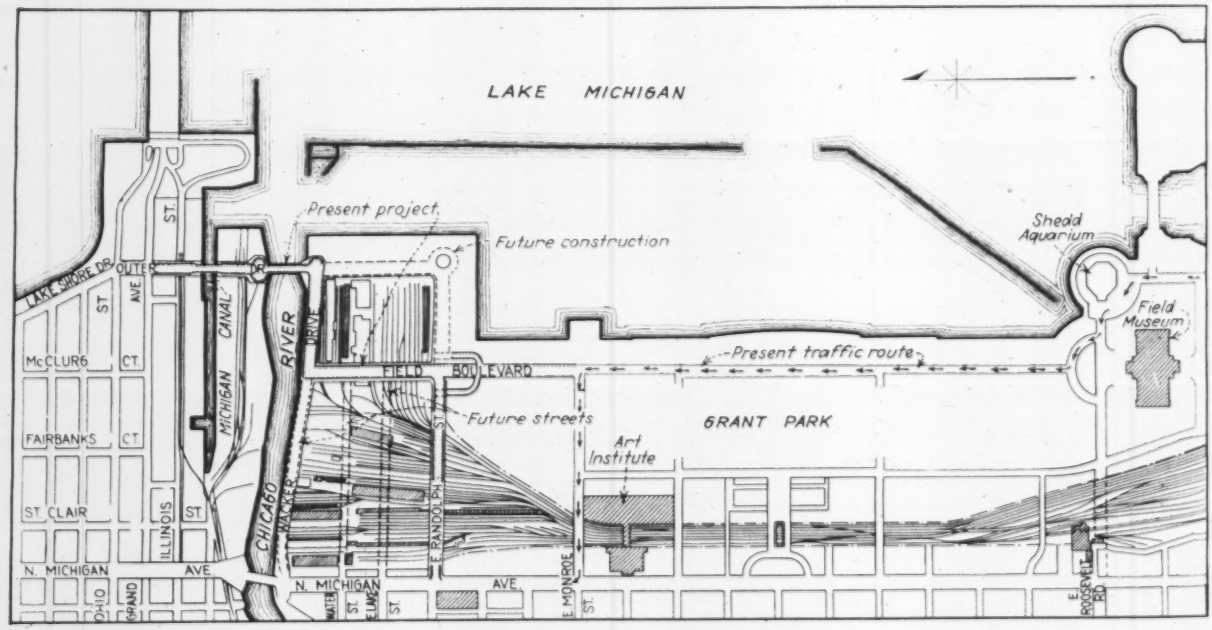
With the Outer Drive Bridge assured of completion this year, attention is now being directed to extensions of the lake front drive north and south from its present terminals at Foster Ave. and Jackson Park (Fig. 1). Since financing prospects are not very bright, only preliminary studies have been made. The plans for extending the Outer Drive north of Foster Ave. to the city limits of Evanston contemplate a chain of islands offshore, linked with bridges and separated from the mainland by lagoons over which shore connections would be made at the principal east and west thoroughfares. A similar scheme for a drive on islands offshore is also being considered by the city of Evanston and other north shore towns.

The problem of extending the Outer Drive south from Jackson Park to Calumet Park is much more complicated because of the fringe of industrial harbors and plants along this section of the lake front. The Chicago Plan Commission has given consideration to four possible routes that converge on two main highways entering the city from the south and southeast, namely, the Dunes Highway and the Dixie Highway. Probably all of the routes eventually will be needed but none is definite enough to warrant detailed description here.

Details in future articles

In conclusion, it remains to point out that the present article is intended as an introduction to subsequent ones, to follow shortly, which will cover the matter of design and construction in considerable detail. The present paper confines the material to the background of the plan, the bridge situation, the traffic features, and the probable effect upon property—particularly that property in the area east of Michigan Ave. and south of the Chicago River. For, after all, elements like these are fundamental in any plan for the construction of a public improvement. Public improvements cannot be expected to come to fulfillment unless there is a demonstrable need for them, and this need and the beneficial effects that are expected to flow from a given improvement are of as great interest to engineer and layman alike, as are the engineering skill, the construction methods and the materials used in consummating the project.

FIG. 3—RELATION of the Outer Drive project to the existing street pattern in Chicago.



The Contracting Business

U. S. Census survey reveals there are 75,000 contractors in the country who did 1.6 billion dollars worth of work in 1935, though 62 per cent of them handled 82 per cent of the contracts

CONTRACTORS in the United States numbered 75,047 in 1935 and performed work that year aggregating $1,622,862,000, according to the construction survey conducted last year by the U. S. Bureau of Census. These firms employed an average of 409,137 persons, not including 69,193 active firm members and proprietors. The annual payroll for employees alone was $470,275,000.

The census was not a complete survey of construction, for only contracting activity was covered, and the large amount of day labor construction and heavy maintenance was not included. Establishments covered by the census include general contractors, operative builders and special trade contractors. The general contractors and builders, while numbering only 15.3 per cent of the total, performed 58.2 per cent of the work. A general summary of contracting classifications from all firms reporting is given in Table I.

The census consisted of a field survey of 69,838 firms doing $500 or more work in 1935. General contractors reported only the value of work done by their own organization so as not to duplicate the value reported by their subcontractors. In addition to the field survey, 5,209 firms were covered by mail. The mail canvass asked for classification of firm and amount of work done only. From the field canvass two general sets of figures have been compiled, one covering all firms so contacted giving classification of contractors, value of work, average number of employees and firm members and payrolls. A further breakdown reports from 46,429 contractors includes a distribution of work done as to new construction and remodeling, private and public, and material and labor expenditures.

Information compiled to date has been published in two volumes. Volume I includes work performed, personnel, payrolls, and cost of materials, by states, cities and by kind of business. Employment by months and by occupational groups by states, cities and kind of business is covered in Volume II.

Of the 69,838 firms reporting details of class of work done, employment and wages, 9,883 were general contractors. Though aggregating only 14 per cent of the total group, the general contractors did 57 per cent of the work employed 63 per cent of the total number of workers and paid 59 per cent of the total payroll. Their expenditures were divided 33.8 per cent for labor, 41.7 per cent for material and 26.0 per cent for general and overhead expenses. They did an average business of $84,400 each, and paid out an average of $1,072 to each employee during the year.

The special trades contractors were divided into seventeen groups, of which plumbing and heating amount to 38 per cent of the total number and did 43 per cent of the subcontractor work. Employees of steel erectors, glaziers and stone setters received the highest annual average income, nearly $1,600 each; the average for the entire group was $1,278.

It is apparent that the special trades groups are for the most part small firms, for the ratio of employees to active proprietors is only 2.5 to 1, as compared with 31 to 1 for general contractors. The carpentering class, for example, lists 8,078 firm members and an average employment of only 6,974.

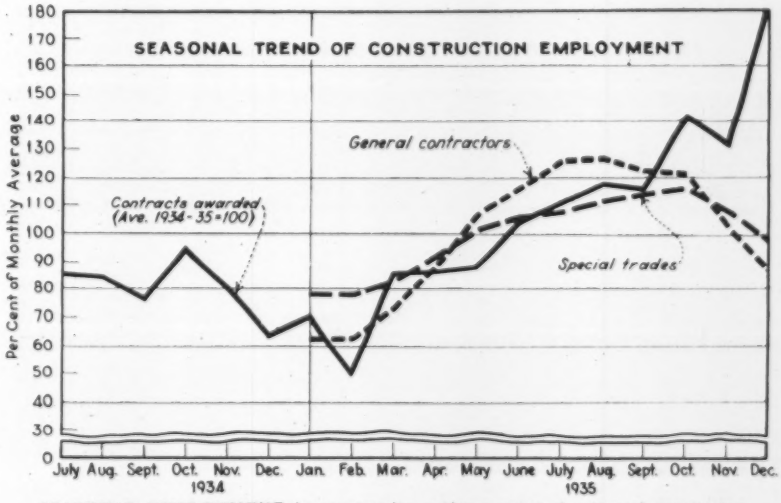
Details of contracting activities and employment by classes of firms are given in Table III.

Seasonal variation

The seasonal trend of construction employment as compared with contract awards in 1935 is shown in the ac-

TABLE I — SUMMARY OF ALL REPORTS

	Contractors Reporting		Value of Work Reported		
	Number	Per cent Total	Total (Thous. $)	Ave. per Firm (Thous. $)	Per cent Total
General Contractors:					
Building	8,337	11.1	398,980	47.9	24.6
Highway	2,116	2.8	280,332	137.2	17.3
Heavy	1,038	1.4	264,967	255.3	16.3
Total	11,491	15.3	944,279	82.2	58.2
Special Trades	63,556	84.7	678,583	10.7	41.8
Grand Total	75,047	100.0	1,622,862	21.7	100.0


SEASONAL TREND OF CONSTRUCTION EMPLOYMENT
Per Cent of Monthly Average
General contractors
Contracts awarded (Ave. 1934-35=100)
Special trades
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
1934
1935

SEASONAL EMPLOYMENT in construction varies most in the general contracting class of work and least in special trades activity. Note that the peak employment by general contractors was in August, while that for special trades was two months later.

TABLE II—CONTRACTING ACTIVITY, PERSONNEL AND WAGE PAYMENTS BY STATES

State	No. Firms	Work Done: Value (Thous. $)	Work Done: Per Cent total U. S.	Personnel: Prop. and Firm Members	Personnel: Employees	Salaries and Wages: Average Annual Wages	Salaries and Wages: Ave. Wages at Site of Work (Cents per hour): Bldg.	Highway	Heavy	Special Trades
N. E.										
Connecticut	1,570	29,990	1.99	1,480	8,833	$1,185	71.1	61.1	59.1	73.3
Maine	638	6,029	0.40	630	1,898	1,061	57.4	37.2	*	59.1
Massachusetts	3,161	54,122	3.74	2,991	13,904	1,327	77.5	61.8	67.3	83.0
New Hampshire	428	5,439	0.35	462	1,459	1,146	61.3	*	*	59.0
Rhode Island	347	7,821	0.52	314	2,299	1,233	70.2	65.5	*	72.2
Vermont	295	1,874	0.14	323	598	988	*	*	*	*
Middle Atlantic										
New Jersey	3,944	48,133	3.18	3,767	11,712	1,308	88.2	63.9	72.6	85.2
New York	10,309	241,074	16.40	9,214	55,957	1,486	83.1	61.9	83.0	97.0
Pennsylvania	5,935	90,108	6.07	6,164	23,932	1,182	70.4	55.1	65.2	77.3
Delaware	222	4,548	0.28	201	1,455	1,127	58.3	39.0	*	66.1
Maryland	1,080	19,391	1.40	1,075	5,776	1,063	65.8	*	51.6	69.1
District of Columbia	376	25,787	1.73	271	6,459	1,344	71.7	46.9	82.4	84.1
South										
Virginia	1,183	20,957	1.41	1,223	6,125	1,016	48.8	35.2	40.2	56.1
West Virginia	618	8,575	0.59	647	3,437	832	58.4	44.0	49.7	70.6
North Carolina	801	20,840	1.56	818	7,036	880	51.5	40.3	49.3	55.7
South Carolina	364	10,124	0.65	353	3,736	858	44.1	40.3	61.0	55.6
Georgia	858	21,960	1.53	828	7,681	856	46.8	34.7	60.9	66.8
Florida	874	26,905	1.79	782	8,886	958	55.3	30.7	56.2	69.8
Alabama	398	8,436	0.74	415	3,217	778	58.9	41.9	32.7	62.4
Kentucky	1,392	15,391	1.04	1,480	5,367	828	54.6	34.0	51.2	63.7
Tennessee	794	21,149	1.36	831	7,969	758	42.1	39.0	51.3	56.8
Mississippi	353	2,645	0.17	381	1,112	656	46.7	28.4	*	47.1
Louisiana	503	15,696	1.05	478	4,724	914	52.6	31.8	52.8	64.3
Arkansas	308	4,750	0.31	330	2,301	561	58.4	40.6	53.6	60.5
Texas	1,672	43,634	2.91	1,722	16,731	802	55.7	41.3	51.8	69.4
Middle West										
Ohio	3,949	68,735	4.80	3,895	17,662	1,261	70.1	59.3	81.7	85.3
Indiana	2,197	27,860	1.96	2,291	7,612	1,044	68.8	52.5	60.7	75.0
Michigan	2,105	52,331	3.63	2,115	14,436	1,287	66.0	51.3	69.9	76.7
Illinois	3,557	115,174	8.04	3,395	31,507	1,312	87.1	70.5	76.7	104.8
Wisconsin	2,757	34,967	2.51	2,709	10,200	1,024	64.3	55.6	61.9	69.4
Minnesota	1,951	45,119	2.94	2,101	16,372	838	65.7	56.5	68.9	75.1
Iowa	1,701	24,219	1.79	1,817	6,616	976	55.6	54.6	56.4	67.0
Missouri	2,267	61,392	4.10	2,184	18,239	1,075	72.6	61.7	67.9	96.3
Oklahoma	567	12,496	0.89	575	3,684	885	53.4	44.5	48.5	62.1
Kansas	991	10,381	0.76	1,066	3,248	833	63.4	52.9	*	60.3
Nebraska	912	16,386	1.15	960	5,303	927	64.1	52.4	64.7	82.8
South Dakota	261	4,358	0.29	270	1,210	921	66.1	50.4	*	*
North Dakota	215	3,217	0.22	235	1,082	807	*	45.6	*	*
Western										
Montana	249	6,578	0.47	260	2,001	1,002	93.0	69.7	*	*
Wyoming	282	3,083	0.20	305	873	1,000	*	*	63.3	*
Colorado	503	9,382	0.84	512	2,763	1,107	82.4	66.7	58.7	88.9
New Mexico	97	3,050	0.23	110	717	1,085	*	58.3	*	*
Arizona	188	4,327	0.33	197	1,443	1,041	73.5	68.9	*	*
Nevada	54	2,048	0.13	53	600	1,263	*	76.8	*	*
Utah	408	8,425	0.64	447	2,634	943	70.9	64.6	*	70.6
Idaho	271	8,208	0.55	308	2,815	1,091	*	56.2	56.3	*
Washington	938	33,302	2.21	933	7,608	1,346	82.7	72.8	84.6	95.3
Oregon	595	20,404	1.49	626	5,542	1,236	79.9	72.0	86.2	83.1
California	4,400	126,450	8.52	4,649	32,366	1,232	74.8	76.4	71.6	83.3

* Figures not shown because an average of less than 100 employees was reported.

companying chart. The trend of contract awards that year was rather abnormal because of a spurt in PWA and highway lettings in the closing months.

Employment in general contracting reached the year's peak in August with 127 per cent of the monthly average, but was only 63 per cent of the average in January. Special trades employment rose steadily from a low of 78 per cent in January to 117 per cent in October.

Employment was most consistent in the special trades group, for here the mean deviation from the monthly average was only 11.3 per cent instead of 17.5 per cent for all classes and 20.6 per cent for general contractors. In the general class, the highway field showed the greatest variation with a mean deviation of 31.8 per cent, while heavy construction was most consistent with a deviation of only 13.8 per cent.

Geographical distribution

The geographical range of construction activity, employment and wages is of interest. Details are shown in Table II, based on reports from 69,838 contractors of all classes.

The number of contracting firms per state varied from 54 in Nevada who did 0.13 per cent of the country's total of work to 10,309 in New York performing 16.4 per cent of the work. Contractors in New York also employed the largest number of workers, an average of 55,957 for the year, and employment was lowest in Vermont, where an average of only 598 workers was found in construction work of all classes.

A glance of Table II will show there is no direct relation between value of work and hourly or annual earnings. Construction workers in New York received an average annual income of $1,486, while those in Arkansas had to be content with $561. The average of annual wage and salary payments was greatest in the areas north of the Ohio and East of the Mississippi Rivers and in the mountain and Pacific States. The South showed the lowest annual incomes, but workers in the Great Plains states fared but little better.

In general, highway employees received the lowest hourly wages at the site of work, while special trades workers were paid the highest. The hourly scale by states does not correspond to the annual income figures. Building trades

TABLE III — VALUE OF WORK, EMPLOYMENT AND PAYROLLS

	Number of firms	Value of Work (Thous. Dollars) Total	Value of Work (Thous. Dollars) Average per firm	Payrolls* (Thous. Dollars) Total	Payrolls* (Thous. Dollars) Average per firm	Proprietors and firm members	Employees† Average number for year	Employees† Average Amount paid	Cost distribution Per cent Labor	Mat.	Gen. and overhead
General Contractors:											
Building	7,241	356,512	49.4	120,316	16.6	6,433	106,366	$1,131	33.7	46.2	20.1
Highway	1,723	240,949	139.9	76,403	44.3	1,298	87,242	875	31.7	40.6	27.7
Heavy	919	236,930	258.0	81,193	88.4	555	64,736	1,255	34.3	36.1	29.6
Total General	9,883	834,391	84.4	277,912	28.2	8,286	258,344	1,072	33.3	41.7	26.0
Special Trades:											
Carpentering	7,633	30,123	3.9	6,894	0.9	8,078	6,974	988	23.9	38.5	37.6
Concreting	946	10,884	11.5	3,897	4.1	971	3,736	1,042	35.9	41.9	22.2
Electrical	7,457	93,229	12.5	30,993	4.1	7,300	21,014	1,470	36.5	41.2	22.3
Elevator instal.	351	21,394	60.7	7,919	22.6	138	4,182	1,890	37.2	53.3	9.5
Excavation and foundation	364	11,913	32.9	4,417	12.1	339	4,005	1,103	37.1	21.2	41.7
Glazing	140	2,425	17.3	806	5.8	115	509	1,586	34.6	40.8	24.6
Heating and plumbing	22,947	269,031	11.7	72,362	3.2	23,238	58,249	1,241	27.5	48.0	24.5
Roofing and sheet metal	5,591	63,385	11.3	18,479	3.3	5,700	16,094	1,150	30.6	43.5	25.9
Masonry	1,031	10,722	10.4	3,856	3.7	1,098	3,167	1,215	36.4	39.0	24.6
Ornamental iron	152	1,385	9.1	403	2.7	138	320	1,260	29.1	45.1	25.8
Painting and decorating	10,633	52,456	4.9	20,469	1.9	11,441	16,229	1,262	42.0	24.5	33.5
Plastering	888	9,878	11.1	4,368	4.9	906	3,278	1,335	45.2	34.4	20.4
Steel erection	105	6,384	60.8	2,389	22.7	67	1,498	1,595	37.4	39.5	23.1
Stone setting	63	1,109	17.6	535	8.5	54	338	1,582	48.4	31.6	20.0
Tile and mantel	727	14,136	19.5	4,847	6.7	620	3,908	1,237	34.5	47.3	18.2
Demolition	128	2,644	20.7	1,060	8.3	119	1,025	1,034	41.5	5.3	53.2
Other	799	22,221	27.8	8,669	10.9	585	6,267	1,380	36.7	38.9	24.6
Total Special Trades	59,955	623,319	10.4	192,363	3.2	60,907	150,793	1,278	32.1	42.6	25.3
Grand Total	69,838	1,457,710	20.6	470,275	6.8	69,193	409,137	1,152	32.8	42.0	25.2

* Does not include compensation for proprietors and firm members. † Not including active proprietors and firm members.

employees, for example, were highest paid in Montana, 93c. per hr., and received the lowest, 42.1c., in Tennessee. Western states also paid better than other sections for highway and heavy construction workers; Nevada led the highway field with 76.8c. per hr. and Oregon the heavy class with 86.4c. The poorest paying states in these classes were Mississippi, 28.4c., and Alabama, 32.7c., respectively. Special trades employees fared best in Illinois, where they received $1.04 per hr., and worst in Mississippi, 47.1c. It is interesting to note that workers in Arkansas, where annual wages were the lowest, received from 40.6 to 58.4c. per hr., depending upon class of work.

Contractors from various states reported a wide range in the proportion of new work and remodeling. The average for the country was 72 per cent new and 28 per cent remodeling, but in Idaho new work amounted to 93 per cent of the total, while in Maine it was only 39 per cent.

The construction census is part of the Census of Business conducted by the Department of Commerce under the general direction of William L. Austin, Director of the Census, from a special office established in Philadelphia. F. A. Gosnell was chief statistician of the census of business, and George J. Lawrence was chief of the construction census.

Template Guides Submarine Trench Excavation

CONSTRUCTION of an ocean outfall sewer for the Los Angeles County Sanitation Districts involved placement of a reinforced-concrete pipe of 5-ft. inside diameter in a trench on the ocean bottom. The first 2,000 ft. of the outfall from the shore end required the blasting of a trench in solid rock for an average depth of about 10 ft. Specifications prohibited blasting within 150 ft. of pipe already laid and jointed; to avoid expensive trimming, therefore, blasting was planned to give clearances of at least 1 ft. all around the pipe. The bottom of the trench then was backfilled with broken rock up to grade, and after pipe sections were placed and jointed, the trench was filled with concrete.

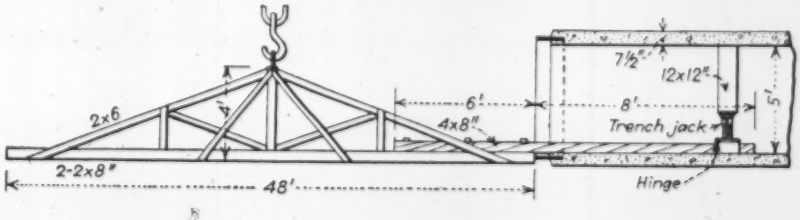
In this portion of the line the pipe was laid by placing and jointing one 18-ft. section at a time. Because of wave action, not until each section was in place was the final preparatory work in the trench done for the next section. After placement of the loose rockfill on the trench bottom, this was leveled off with a submarine drag consisting of a heavy steel beam. Then a wooden template, as shown below, was used to check the work.

The template truss was made of wood and weighted with metal so that the immersed weight would be only about 100 lb. With this slight negative buoyancy there was assurance that the 48-ft. straightedge would remain without curvature when fastened in place at the rear end. The rear end of the template was jacked against the invert of the forward end of the pipe section last laid, thus holding the truss over the trench centerline where it was a guide for the diver in determining just what additional trimming or other work in the trench remained to be done.

The rock formation is shale and is soft enough so projecting points or "boots" could be removed with a heavy bucket. When boots were found within 150 ft. of laid sections they were removed by dropping upon them a 14-ton Argyle bucket with a jaw spread of 16 ft. and a transverse width of 8 ft. With careful blasting, followed by this effective means of removing projections, the trench was excavated satisfactorily.

The outfall is being laid for the Los Angeles County Sanitation Districts by the Merritt-Chapman & Scott Corp.

A SUBMARINE TEMPLATE fastened to and projecting from the pipe section last laid, used in rock trench by diver to check grade and clearance on sides.



Getting Rid of Road Zigzags In Michigan Highways

Three diagonal trunk highways being provided by revamping old roads and building new links on direct across-state routes

By Murray D. Van Wagoner
Michigan State Highway Commissioner, Lansing, Mich.

ROADBUILDERS have a greatly extended field of work in the progress of new planning for arterial or long-haul direct point-to-point highways. These roads present a combination task of revamping old roadways and pavements, of part rectification of old line and profile and of building entirely new connecting roads that calls for exceptional versatility of construction planning and procedure. So in setting out on its plan for diagonal across-state roads, Michigan is presenting variety and volume of construction besides giving a service for which road transport is calling. The diagonal road system is more than a plan in the making; it is a project in process of construction.

Why the need

"Cross-lots is the shortest way home," was the homely way in which the early settlers of Michigan expressed the Euclidian axiom that a straight line is the shortest distance between two points. They knew their geometry, but that knowledge didn't prevent them from permitting the adoption of the checkerboard as a pattern for their highway systems, and today no small part of the work of the Michigan state highway department is directed toward the correction of that early error. In essence the present development of diagonal highways is Michigan's method of obviating some of the inefficiency that was inherent in the early system.

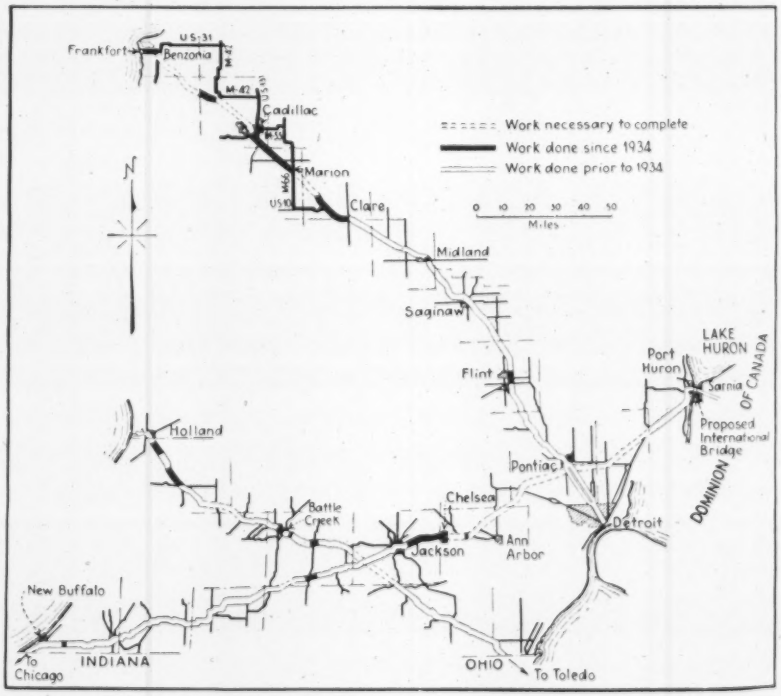
It would be unfair to assess all the blame for checkerboard roads against the pioneers, for, when left to themselves, they did make diagonal roads. The road from Detroit to Saginaw and northwest (now U.S. 10), one from Detroit to Grand Rapids (U.S. 16), another from Detroit west to Lake Michigan (U.S. 12) and finally one from Jackson southwest to the Indiana line (M. 60)—all in a measure diagonals—were originally trails that the pioneers, bound for distant homesteads, cut straight through virgin country where the surveyor had not yet set his marks.

Nevertheless, the checkerboard plan originated with the settlement of the state, though it was the U. S. Land Office and its surveyors that were responsible. For the purpose of dividing and describing lands in the vast area of territorial Michigan, the pattern of squares was logical and convenient. The model county was 36 mi. square, the township 6 mi. square, and the section 1 mi. square. When the pioneer settler took up his land in sections or fractions thereof, he insisted that there should be a road past his door, and this demand was satisfied by building roads on the section lines.

When the era of hard-surface highways came, with the advent of the automobile, it was natural that the existing roads should be improved. In the first place, it was cheaper, for, according to the accepted road construction standard of that time, the old grades were entirely adequate as a base for the new concrete or other type of surface. In the second place, the tremendous potentialities of automotive transportation were slow in percolating into the popular understanding, and because few thought of the possibility of traveling long distances by motor car, few saw any need for good roads leading farther than to the next town. The first paved highways were built largely from motives of local convenience and local pride.

So the early hard-surface highway system, if it could be called a system, grew up like Topsy. Even when trunklines began to be developed, about twenty years ago, they were formed by connect-

FIG. 1—CUTTING ACROSS its checkerboard of section-line roads, Michigan is building three diagonal trunk highways; one will provide a short-cut between the metropolitan area of Detroit and the northwestern playground of the state, the second is the proposed Chicago-to-Montreal diagonal through Michigan and the third is a direct route between Holland, Mich., and Toledo, Ohio.



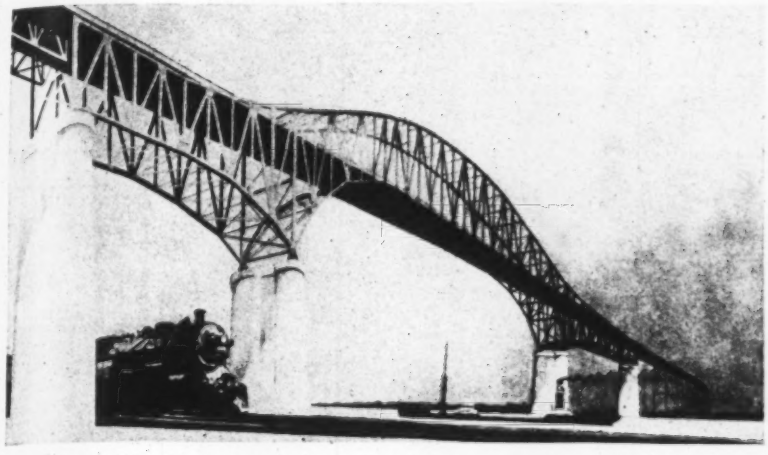


FIG. 2—**INTERNATIONAL BRIDGE**, to be built soon over the St. Clair River between Port Huron, Mich., and Sarnia, Ont., which will form a vital link in the proposed Chicago-to-Montreal diagonal road through Michigan. This photograph of a model shows the main bridge, a cantilever structure with an 871-ft. channel span and 326-ft. anchor arms. Each approach consists of two deck trusses and a plate girder viaduct.

FIG. 3—**A RECENTLY COMPLETED SECTION** of the new Clare-Frankfort diagonal highway; when finally completed this new road will save 56 miles of driving distance between Detroit and northwestern Michigan. Long sight distances, wide shoulders and gentle curves are features of this new direct route.

ing up these patches of pavement which already had been built, and if one of them did not happen to be in the direct line of the route, the new construction jogged over to tie it into the road. In other words, early pavements on the trunk line system tended to stabilize and make permanent some of the worst features of the old roads.

As automotive traffic became heavier and as its average speed increased, the practice of highway engineering and construction changed. Sharp turns were replaced with long easy curves, many of the jogs were eliminated, and every effort was made to adjust the existing roads to the increasing load and to develop them into an efficient state-wide system of highway transportation. But the fundamentals of the old system were unchanged.

So now Michigan is building direct point-to-point diagonal highways. These trunk lines are being superimposed on the old checkerboard system; they utilize existing roads only where they are in the direct line of the shortest route, but where there are no such roads, the diagonal cuts straight through with entirely new construction.

The present diagonals

There are three diagonals now under construction, and the purpose of each is either to shorten travel distance or to bypass traffic around congested urban areas. These diagonals (see Fig. 1) are:

1. A short-cut route between Clare and Frankfort which will save more than 50 miles in the driving distance between the Detroit metropolitan area and the scenic playgrounds in the northwestern part of the state.

2. A diagonal between New Buffalo, close to the Indiana state line in southwestern Michigan, and Port Huron, a gateway to eastern Canada. It will be the Michigan section of the projected Chicago-Montreal international highway.

3. The diagonal from Toledo to Holland, which will offer tourists from Ohio and other southeastern states a direct route to the Lake Michigan resort section.

Of the three diagonals, the best known and furthest advanced is the one between Clare and Frankfort. With the completion of the 1936 construction program, all but 60 mi. of the diagonal is hard-surfaced and of this remaining mileage a considerable part is graded.

A Detroit motorist bound for Frankfort now goes northwest through Pontiac, Flint, Saginaw, Midland and on to Clare. This much of the trip is direct; but from Clare to Frankfort the route is circuitous, and it is in this section that the diagonal highway is being built. Before this construction began, traffic (see Fig. 1) followed U.S.-10 out of Clare through Farwell, turned north on M-66 through Marion and went into Cadillac on M-55. From that city it went north on US-131, turned west, then north on M-42, and west and south on US-31 into Benzonia, whence it took M-115 west into Frankfort. The travel distance from Clare to Frankfort by this route was 146 mi.

When the diagonal construction is completed, however, this distance will be reduced by more than 50 mi., as the new route will take an almost straight line from Clare to Frankfort. The construction completed in 1936 consisted of over 17 miles of 20-ft. concrete pavement between Marion and Cadillac. Several miles of grading and drainage work have been done southeast and northwest of this section. Included in the latter work is a grade separation in the neighborhood of Cadillac which is practically finished.

At Frankfort there is a ferry connection with Menominee across Lake Michigan. Menominee is a gateway to a very large area in the western part of the Upper Peninsula, and the use of the ferry and the completed diagonal will shorten driving distance between Detroit and points in this section by more than 150 miles.

The diagonal which will form the Michigan section of the Chicago-Montreal highway will provide a better and quicker route and is expected to result in a major shift of traffic between the Midwest and points in eastern Canada and eastern United States. Although this diagonal will not greatly lessen the mileage of the present route which passes through Detroit, it is believed that a very large proportion of the traffic will welcome the opportunity to avoid the heavy congestion in the metropolitan area. The diagonal runs from New Buffalo to Jackson through Pontiac to Port Huron. The only actual gap in this route is between Chelsea and Pontiac, though a considerable mileage

southwest of Jackson requires straightening and other modernization.

An important link in the Chicago-Montreal highway is a projected international bridge across the St. Clair River between Port Huron and Sarnia, the gateway city to Ontario. An agreement for its joint construction was reached some months ago under which the Michigan and Ontario highway authorities will build their respective approaches, while the cost of the main structure, to be built by the specially created Michigan State Bridge Commission, will be met by tolls.

Construction on the Holland-Toledo diagonal, which is aimed to make the Lake Michigan resort country more accessible to visitors from Ohio, has been limited so far to improvements on existing highways which are destined to become links in the projected interstate trunk-line.

Future holds more

The field of the state highway department's plans for direct point-to-point trunk-lines is not limited to the southern part of the state. A diagonal, shortening the travel distance between the southwestern border of the Upper Peninsula and the Canadian gateway at Sault Ste. Marie, is a project on which development will be continued in future programs.

During the past three years, Michigan has invested more than $4,000,000 in the development of these shorter more-direct highways. As has been pointed out, a very large proportion of this expenditure has been on existing roads where improvements have a use and a value even before the diagonal highway is entirely completed. It will cost several more millions of dollars before the projected diagonals are finished, but the state highway department is convinced that the investment will be a very profitable one.

Diagonal highways are a perfectly logical and natural step in the development of an effective trunk-line system. In Michigan they are looked on as one of the final steps in freeing the motor car from horse-and-buggy roads.

Consolidated Sewer Services Popular in New Jersey

THERE are 80 municipalities, representing one-half of the total population of New Jersey, which have consolidated their sanitation services of sewage treatment and disposal by using 19 plants. These municipalities represent three-quarters of the population of the state served with sewage treatment facilities. According to the Princeton Local Government Survey, this puts New Jersey first among all the states in proportion to the population served by sewer systems, and close to the top on consolidated sewer services.

Roadside Erosion Control Studied By Soil Conservation Service

Demonstration operations in progress on two Arkansas highways expected to develop definite practices for preventing destructive wash

By Arnold Davis

Associate Agricultural Engineer, Soil Conservation Service, Fort Worth, Tex.

IN REGION 4 of the Soil Conservation Service, which includes the states of Louisiana, Arkansas and Texas (except the high plains region) there are over 500,000 miles of road ditches, in the construction of which practically no consideration was given to the problem of erosion. The quantity of soil that has been removed from these ditches by rushing rain waters is enormous and most of it was unproductive subsoil which has been deposited over highly productive lowlands.

Why is erosion

Insufficient right-of-way is one of the principal causes of severe highway erosion. A completely safe and stable highway cannot be constructed on a ribbon right-of-way, nor can complete erosion control be obtained along highways that do not have width. To assure erosion control, slopes have to be flat, and outside water be either diverted or brought onto the right-of-way over a protected area. Ditches must be drainageways designed for a desired velocity to prevent scouring and to minimize silting; as the velocity of runoff water increases beyond a safe point, the drainageway should be widened—not deepened. Flat-bottom ditches must be used in the place of the V-bottom ditch which is more susceptible to erosion. Drainageway elevation has to be kept high in reference to the center line of the highway and designed to allow at least 6 in. of free board, based on the maximum probable rainfall intensity of 50-year frequency. Also the drainageway has to be kept away from the subgrade or bases; this is especially true on flexible-base roads.

Field study started

The Soil Conservation Service plans to cooperate with state highway departments in constructing a number of highway erosion-control demonstrations. The Bureau of Public Roads will approve the expenditure of funds through the regular federal-aid program in order that this work may get under way. The demonstrations are cooperative projects between the Soil Conservation Service and the respective state highway departments. The general plan is for the highway department to furnish materials and construction machinery, and the Soil Conservation Service to furnish supervision and available labor.

The demonstrations will be definitely planned before construction is started. Methods used in carrying them out will

FIG. 1—GULLIED DITCH BANKS on the Russellville demonstration; the treatment is to flatten and revegetate the slopes.

FIG. 2—THIS DEEP WASH on the Forrest City demonstration area is a case in which a drop inlet is to be constructed to raise the ditch level about 8 ft.

vary in the type of sod, method or re-vegetation, use of topsoil and fertilizers and the use of nurse crops for protection of the soil until nature can spread a permanent cover of native grasses. Waterways will be designed for desired velocity, and unprotected overfalls will be eliminated. Drainage structures endangered by encroaching gullies will be protected by vines or mechanical means. The use of intercepting terraces constructed on non-erosive grades will be demonstrated. All ditches will be eliminated, even to the word itself, drainage and waterways will be used. Figs. 1 and 2 show the existing conditions on two projects now under construction in Arkansas.

One project is located in the Crowley Ridge area along a stretch of highway extending 2½ mi. from Forrest City. The soils in this region are wind blown or loessial and alluvium and the area is subject to severe water erosion. The soil makes it easy to grow vegetation, but due to its high erodibility it is very difficult to hold in place until vegetation can be established.

An extensive use will be made of the U-type drop inlet, which will raise the elevation of the drainageways to grades not exceeding that of the road. Methods in establishing the Bermuda grass, which will serve as a permanent cover, will be varied over the project area. Commercial fertilizer will be used with winter cover crops of Abruzzi rye, red May wheat, winter turf oats and Italian rye grass; these winter nurse crops will be followed in some sections with a spring cover of hop clover and lespedeza to determine whether the native permanent cover will need additional protection.

The demonstration at Russellville, Ark., is possibly not as difficult as that at Forrest City, because the soil is less erodible, but there are other problems to be solved.

The Russellville project is divided into twelve sections according to soil type, slope and field conditions. Each of the sections will be treated differently. For instance, the first section from station 0 to 10 is similar in slope design, but the soil types in this section are silt loam, gravelly fine sandy loam and shale loam. This section will be revegetated by establishing Bermuda sod and seeded to Abruzzi rye at a rate of 90 lb. per acre. The rye will serve as a cover crop until the sod is well established. Masonry drop inlets will be used with different elevations from the drainageway and waterway.

The lower side of the roadway offers the problem of damage to agricultural lands by run-off from the road. The plan in the erosion-control demonstration is to levee out the ditch tail across the flat sections where they open onto cultivated fields to a point where a permanent pasture is located. Here cut-outs will be constructed and the water distributed evenly over the protected pasture area. Where the tailouts are over protected areas, the water will be cut out at intervals of 50 ft. or less if necessary.

Orange Grove Surveys Require No Axmen

RUNNING preliminary location lines for the distribution system of the Metropolitan Water District of Southern California involved surveys for many miles through orange groves where the trees have a relatively high value.

Under these conditions survey crews were instructed to avoid cutting or otherwise damaging the trees. The result is survey procedure as shown in the accompanying illustration. Transitmen use stubby-legged tripods of the sort on which instruments frequently are exhibited in show windows; in making the observations the transitmen assume a prayerful attitude while rodmen and stake artists similarly crouch under the next tree on line; the lower branches are carefully lifted out of the way while a through sight is completed or a hub is set.

SURVEYING on the aqueduct location through an orange grove of Southern California.

Brownsville Port Development

Channel for deep-draft vessels cut from the Gulf of Mexico 18 miles to a large turning basin where wharves and other port facilities have been built—New work now under way to meet growing traffic needs

By C. J. Howard
Resident Engineer, Brownsville Navigation District, Brownsville, Tex.

TO THE CHAIN of deep water ports along the Texas coast which have shown such remarkable development during the past 20 years there has been added an entirely new link at the extreme southern tip of the state, the Port of Brownsville. Strategically located to serve southern Texas and northern Mexico, a bright future for this newest of Gulf ports seems assured. Involved in the development are the following: Heavy rock jetties guarding the entrance to a dredged channel leading to a turning basin in comparatively high ground 7½ mi. from Brownsville, and terminal facilities at the turning basin, including a concrete wharf, transit sheds, rail and highway connections, water and other utilities and a separate oil dock.

Brownsville is situated on the Rio Grande 22 mi. from the Gulf by an overland route but much farther by the very tortuous river route. During the early days of the development of the state and continuing until about 1870, the Rio Grande was an important artery of commerce with light draft vessels ascending from the Gulf to various landings on each side of the river. At times these vessels were the principal shipping facility for an extensive territory. Later, light-draft shipping was carried on through Point Isabel, 25 mi. distant on the coast, that port having been connected to Brownsville by one of the early railroads of the state. (This connection was practically abandoned when trunkline railroads were built into the valley.)

In subsequent years several projects for channel and harbor development in the vicinity of Point Isabel were planned, with minor construction work carried on by both the federal government and local interests, but none proved of permanent value, due largely to the limited depth of water they provided.

Such was the situation until the Brownsville Navigation District was organized in January, 1929, and definite steps were taken to secure a depth of 25 ft. for a channel to a port to be located near the city. After approval by the Board of Engineers for Rivers and Harbors, this project was definitely provided for by the Rivers and Harbors Act of 1930. That act provided for a jetty-protected entrance channel at Brazos Santiago Pass as a federal project. The channel from the inner side of the pass to and including a turning basin at the port site was to be constructed by the Corps of Engineers with funds furnished by local interests. Local interests also were required to provide suitable terminal facilities satisfactory to the Chief of Engineers.

Brazos Santiago Pass, 7 mi. north of the mouth of the Rio Grande, is the natural entrance to Laguna Madre from the Gulf between Padre and Brazos islands, which are sandspits and roughly parallel the general coast line 5 mi. out. Work on the entrance channel under the present project was commenced during December, 1933 and completed in July, 1935. Through the parallel portion the jetties are 1,200 ft. apart, 5,200 ft. long and extend to the contour of 25-ft. depth in the Gulf. They are of the usual rubble-mound type and present an exceptionally thorough and excellent job of close fitting of the huge granite slope blocks and cap stones. Together with the dredging that has been done they have produced a channel of the project depth for a width of 300 ft. and extending directly west through the pass for one mile. In the construction of the jetties, 417,400 tons of stone was used at a cost of $2,727,000. The total cost of the entrance channel was $2,907,000, all of which was borne by the federal government.

The dredged channel to the Brownsville port is entirely artificial. Commencing on an easy curve from the inner end of the entrance channel, it continues southwesterly with only a few slight bends for 16¾ mi. to the turning basin at its head. The channel has been completed to its project dimensions of 100-ft. bottom width and 25-ft. depth below mean low tide. For four miles from the pass the channel traverses the shallow waters of Laguna Madre, cutting through a few small islands; for the next eight miles the terrain is principally low ground and tidal flats, beyond which the ground gradually rises until an elevation of 10 ft. is reached at the site of the Brownsville harbor. The turning basin at the head of the channel, constituting the harbor proper, is 1,000 ft. wide and 1,300 ft. long, bottom dimensions, and is dredged to the present project depth of 25 ft. It is 7.5 mi. from the business section of the city and 3 mi. from the nearest point on the Rio Grande. Dredging of the channel from the pass to and including the turning basin involved the movement of 17,321,000 cu. yd. of material, principally clay, at a cost of $1,545,000.

For the harbor site the Navigation District has secured 700 acres of land surrounding the turning basin. In addition to providing ample space for future as well as present terminal facilities, it is contemplated that much of this property will be leased to industries desiring locations close to the terminal. This harbor site, at its convenient distance from the open sea and with its natural ground elevation, offers excellent protection from Gulf storms. The Navigation District also owns a strip of property ½ mi. wide along the channel from Laguna Madre to the port site.

The initial terminal facilities have been concentrated on the north side of the turning basin, the west and south sides being reserved for future development. Should future demands require an enlargement of the turning basin it is contemplated that this will be made toward the east, the channel being widened to the width of the basin so far as may be necessary.

Concrete wharf

The principal feature of the present facilities is a margin-type reinforced concrete wharf on concrete piles extending along almost the entire frontage of the north side of the turning basin, its length being 1,220 ft., width 76½ ft. and deck 15 ft. above mean low tide, except the front 35 ft. where a slope of 4 in. is provided for drainage. The wharf is designed for a uniform load of 500 lb. per sq. ft. with the track portion designed for Cooper's E50 loading.

The transverse pile bents of the wharf are spaced on 10-ft. centers and

FIG. 1—TURNING BASIN and terminal facilities at Brownsville Harbor with ship channel dredged to the Gulf of Mexico 18 miles away.

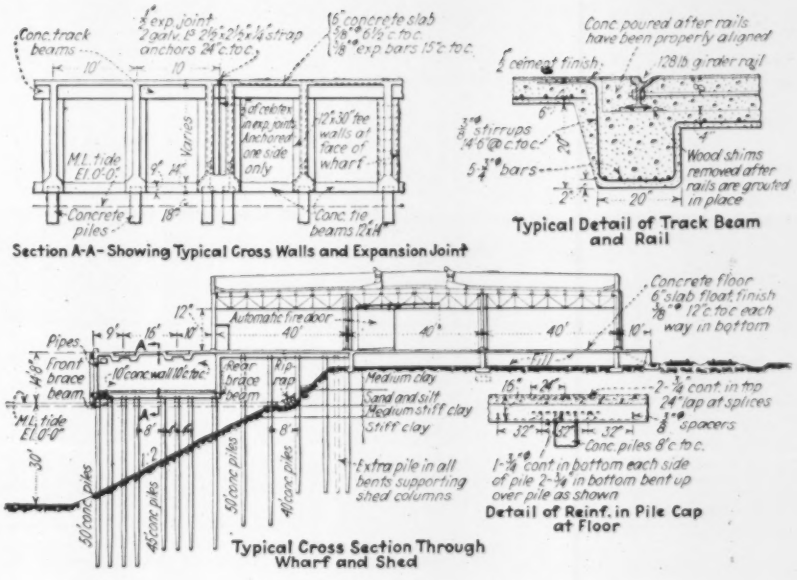

Conc. track beams
Concrete piles
M.L. tide El. 0'-0"
Varies
Conc. tie beams 12x14
Section A-A-Showing Typical Cross Walls and Expansion Joint
Conc. poured after rails have been properly aligned
Cement finish
128 lb. girder rail
Wood shims removed after rails are grouted in place
Typical Detail of Track Beam and Rail
Automatic fire door
Concrete floor 6" slab float finish
Pipes
Front brace beam
Rear brace beam
Rip-rap
Medium clay
Sand and silt
Medium stiff clay
Stiff clay
Extra pile in all bents supporting shed columns
Conc. piles 8' c to c.
Detail of Reinf. in Pile Cap at Floor
Typical Cross Section Through Wharf and Shed

FIG. 2—THE WHARF is notable for the manner in which stiffness is obtained through the use of concrete walls perpendicular to the face against which vessels are berthed.

extend across the sloping bank of the turning basin from near the bottom line of the cut to 5 ft. back of its top line at the original ground surface. Through the outer 37 ft. of the wharf width the top of the piles is at El. 2.5 ft., a typical bent of this section consisting of four 50-ft. and four 45-ft. piles. Over these piles above El. 1.7 ft. is poured a concrete cap 30 in. wide and 24 in. deep upon which a solid concrete wall 10 in. thick rises to the under side of the 6-in. deck slab, each end of the wall terminating in a vertical 12x30-in. T-section. For longitudinal stiffness the pile caps are tied together through each panel with three 12x14-in. strut beams. A similar beam occurs under the outer edge of the deck slab, spanning between the end tees of the transverse walls. The deck floor slab is carried directly on the transverse walls in 10-ft. bays. Under each of the four track rails along the wharf is a 20x18-in. beam, these beams likewise spanning between the walls.

Through the rear 41½ ft. of the wharf the pile bents are continued on 10-ft. centers, a typical bent consisting of two 50-ft. and three 40-ft. piles. The top of these piles is at El. 14, and over them is an 18x30-in. concrete cap which carries the deck slab. The concrete in the deck of the two sections of the wharf was deposited simultaneously, thus effectually tying them together. All concrete piles are 16 in. square with the tip tapering to 10 in. square in a length of 10 ft., and are heavily reinforced.

To allow for temperature changes, the wharf is built in sections 140 ft. long and a ½-in. open expansion joint is provided through the deck between adjoining sections. Where these expansion joints occur the pile caps of both sections of the wharf are made 5 ft. wide to allow for two rows of staggered piles, two transverse walls being provided over such caps in the front section. The rear section caps are cut through with an open joint in the same manner that the remainder of the deck structure has been cut.

The outer or front section of the wharf carries two standard-gage railroad tracks on 16-ft. centers, the top of the rail being flush with the deck surface. For placing these tracks, two depressed troughs 6 ft. 4 in. wide were formed in the deck between the special track beams previously mentioned; the rails being later laid in the troughs without ties, but cross connected in each track with 1-in. rods 5 ft. apart. After the rails were properly aligned and grouted to grade, the troughs were poured with a solid concrete fill. Girder rails of 128-lb. section were used to permit finishing the concrete directly against the rail heads on each side which greatly facilitates trucking over them. In the rails at the expansion

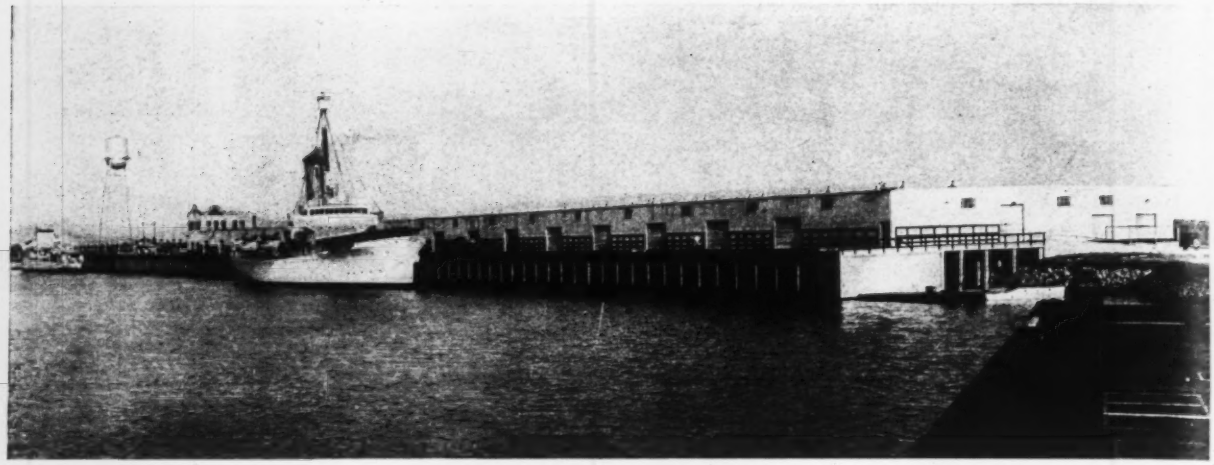


FIG. 3—VESSELS are berthed along the wide wharf where cargo can be transferred directly to railroad cars or trucks or can be moved conveniently to the transit sheds.

joints in the wharf deck ½-in. free joints were provided.

The entire surface of the 6-in. wharf deck was finished with a monolithically applied mixture of traprock screenings and cement, troweled smooth. All corners of the slab subject to abrasion from trucking are protected by galvanized-steel angle sections anchored in the concrete. Along the front of the wharf a number of heavy cast-iron cleats bolted to the deck furnish mooring facilities for vessels. As the wharf deck averages 5 ft. higher than the ground at its rear side, a concrete curtain wall 8 in. thick and 6 ft. high is provided throughout the length of the wharf to form a rear bulkhead. From the west end of the wharf a 90-ft. extension of the outer or front section forms a trestle across the west end slope of the turning basin by which the wharf tracks are carried to a connection with the approach tracks built on an earth fill up to that point from the west.

Throughout its height the outer face of the concrete wharf structure is protected from damage by vessels with a fender system of heavy creosoted timbers bolted to the vertical and horizontal concrete members. A creosoted timber wharf log is provided along the outer edge of the deck surface.

The slope of the turning basin bank through the length of the wharf and trestle, and for 50 ft. beyond each end is protected from wave action between El. 0 and El. 7, with a 2-ft. blanket of stone riprap.

Transit sheds

Two transit sheds have been provided along the wharf, beginning near its eastern end, each of these being 120 ft. wide and 400 ft. long, the two being separated by a concrete fire wall rising to 5 ft. above the roof. The front wall of the sheds is 35 ft. from the front of the wharf, thus providing a wide wharf apron throughout the length of the sheds. The rear wall of the sheds is 78½ ft. back of the rear line of the wharf, beyond which a 10-ft. receiving platform is provided. The 6-in. reinforced concrete floor of the shed behind the wharf and that of the receiving platform are level with the wharf deck at El. 15, these floors being placed on an earth fill extending from the curtain wall along the rear of the wharf to a retaining wall at the outer edge of the platform. Retaining walls for each end of the shed are returned from the platform wall to the wharf curtain wall.

Designed for high winds

The transit sheds are of steel frame construction with riveted connections throughout. Being designed to withstand winds of hurricane velocity, the steel structure is especially well braced. Columns provide three 40-ft. transverse bays, the bents being on 20-ft. centers. In each bent two columns are carried on the wharf structure and two are on concrete plinths extending to spread footings 4 ft. below the ground surface. The roof trusses of modified Pratt type, have a depth of 5 ft. at the wall line, 6 ft. at the center and provide a clear height of 12 ft. above the floor. Wall girts are steel members and the siding is 24-gage corrugated galvanized steel. The roof is of mill construction with 4x12-in. timber joists spanning between the roof trusses on 5-ft. centers, and 2x6-in. T and G decking. The roofing is of the four-ply felt, tar-and-gravel built-up type.

Steel sash in alternate bays of the walls and a number of combination skylights and ventilators in each shed provide light and ventilation. Along the wharf side are 14x10-ft. rolling steel doors and along the rear side are 8x8-ft. sliding steel doors in alternate bays. A 10x12-ft. opening provides passageway through the fire wall, this being protected by automatic fire doors on each side. Each end wall has one 12x10-ft. door for the entrance of vehicles and two 10x8-ft. doors for loading direct to or from vehicles on the outside. Except at the doors the outer face of the walls is protected for a height of 6 ft. above the floor by a creosoted timber fender system consisting of 2x6-in. rails on 4x4-in. posts, securely fastened against the corrugated siding by bolts extending to the steel frame members.

In the southwest corner of the west shed a 40x40-ft. space is devoted to office purposes, a two-story structure being provided there. Each floor of this structure has been divided into several neatly finished office rooms for the use of the port's operating force and of the shipping interests. For insulation the outside wall sheeting is of corrugated asbestos.

Truck and rail connections

The 380-ft. length of the wharf west of the transit sheds is planned to be used as an open wharf for the more convenient handling of such cargo as is not desirable to be passed through the transit sheds. Featuring the increased use of motor trucks for general and long distance hauling, there has been provided along the rear of this portion of the wharf a concrete paved truck yard 88.5 ft. wide, depressed to 4 ft. below the elevation of the wharf. This yard forms a convenient space for direct loading between wharf and trucks, and also for maneuvering trucks in general movements to and from the wharf and the sheds. Two ramps provide access from the truck yard to the open wharf and one ramp leads to the west entrance door of the sheds. A similar but smaller truck yard at the

east end of the shed furnishes a ramped entrance to the main east door and also loading access to the two smaller doors.

As a part of the terminal construction, three miles of railway track has been constructed at the port site, providing for connections to the two wharf tracks, two tracks along the shed receiving platform and the truck yards, these being depressed to car-floor height below the shed floor, and one track to serve industries along the north side of the property. The tracks are laid with 75-lb. rail, creosoted ties and gravel ballast. The main lead of these tracks extends to the boundary of the district's property near the northwest corner, from which point a ¾-mi. spur has been built by the Point Isabel & Rio Grande Ry. to its line six miles from Brownsville. At the city this line connects with the tracks of the Southern Pacific and Missouri Pacific systems, the latter of which maintains a connection across the Rio Grande to the National Lines of Mexico at Matamoros. The Brownsville switching limits have been extended to include all the tracks at the port site, thus placing these on the same basis as other industry tracks within the limits.

The port site has excellent highway connections to Brownsville and by connecting roads to the general valley highway system. An extension of one of the state highways traverses the property, the concrete paving of this road paralleling the wharf 85 ft. from the rear side of the sheds. From this road concrete paved approaches provide two entrances to the west truck yard and one to the east truck yard.

An electric lighting system has been provided for the facilities, current being secured from a transmission line built to the port site as an extension of the Brownsville municipal system.

Water for domestic use and fire protection at the port is secured from the Brownsville municipal supply through a 12 and 16-in. cast-iron main, laid from the city as a portion of the terminal improvements. Normal static pressure from the city system is 75 lb. per sq. in. but as an auxiliary supply for the sprinkler system, a 100,000-gal. elevated steel tank 100 ft. high has been erected. Also, a standard electrically-driven fire pump of 1,000-g.p.m. capacity has been installed, the supply for this being a 200,000-gal. concrete-lined earthen reservoir. A small booster pump fills the elevated tank from the reservoir in case of interruption in the city supply.

Oil dock

A separate oil dock has been built along the northeast side of the turning basin where the width of the channel flares out to that of the basin. Here a row of five timber pile clusters is provided, against which tankers can be docked, mooring facilities being furnished by four heavy cast-iron bits founded on concrete bases along the top of the bank. A 20x83-ft. pile-and-timber wharf fronting the line of the clusters is provided as a working space and support for oil hose lines. A runway of similar construction, beneath which oil lines may be suspended, connects this wharf with a 16x83-ft. timber loading platform on the shore, over which package goods may be handled. All piles and timber used in this construction are creosoted southern yellow pine, the piles and such bracing timbers as are in the water having 22-lb. treatment and the timber above the water having 12-lb. treatment. A graveled roadway connects this wharf with the east truck yard of the main wharf and a graveled truck yard is provided at the rear of the loading platform. One major oil company has laid lines to the dock from its bulk distributing station near the north side of the property and it is contemplated that others will follow.

The contract costs of the terminal facilities are given in the accompanying table.

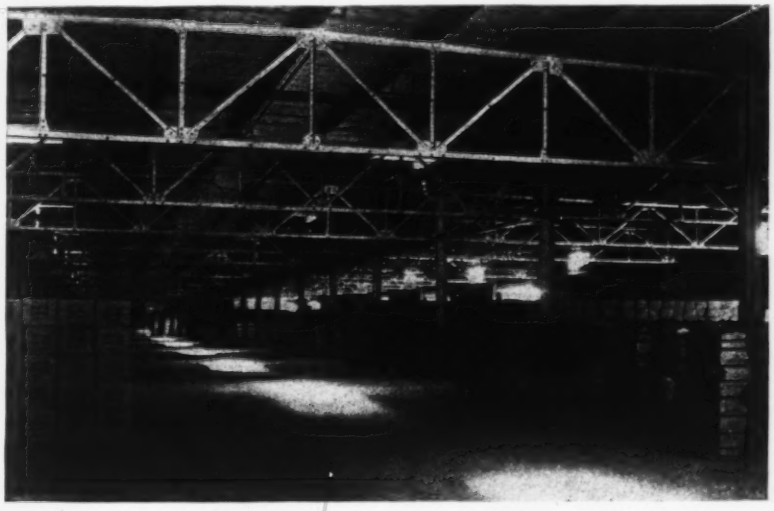


FIG. 4—THE TRANSIT SHED has a steel frame designed to resist hurricanes and a mill construction roof on which is laid four-ply felt and tar and gravel.

COST OF PORT FACILITIES

Main wharf and transit sheds, including truck yards, sprinkler system, wiring, etc.	$498,000
Railway trackage	50,700
Water mains and fire protection	150,800
Oil dock	18,200
Mechanical equipment and furniture	22,800
	$740,500

During the first six months of the port's operation the development of business was so active that the officials were brought to a realization of the early need for additional wharfage facilities. On Dec. 16, 1936 a contract was awarded for a unit to be built at the west end of the turning basin. This will consist of a wharf 440 ft. long and a 120x400-ft. transit shed with necessary trackage, roadways, etc., the layout being similar and the type of construction following that of the present units as herein described. Shipping interests have already asked for additional depth of water as being necessary for business they contemplate handling through the port. This phase of the project is now under consideration by the Corps of Engineers, with a view of increasing the channel and turning basin to a depth of 30 ft.

The Brownsville Navigation District is a special political subdivision organized under the state laws; it comprises an area of 330 sq. mi. being about one-third of Cameron County and including the City of Brownsville. Its affairs are administered by a board of three commissioners elected bi-annually; the executive officer of this board, directly in charge of all matters connected with operation of the port, is the appointive port director. All costs to the district for development and construction of the project, about $2,500,000, have been met by tax-supported bond issues supplemented by a PWA grant. All work connected with the project directed by the Corps of Engineers has been under the district office at Galveston, Tex., Col. E. H. Marks having been district engineer throughout the construction period. From the inception of the Brownsville Navigation District, Robert J. Cummins, Houston, Tex., has been its consulting engineer, directing many phases of the district's activities throughout their development and having direct responsibility for the design and construction of all features of the terminal facilities.

Hollow Concrete Rigid Frames Support Auditorium Roof

Spanning 77 ft. in a California school, this unusual framing promises economy, earthquake resistance and effective architectural appearance.

By William T. Wright
Chief Structural Engineer, with T. C. Kistner, Architect, Los Angeles, Calif.

A HOLLOW-GIRDER ROOF, one of the first of its kind, recently was built for an auditorium at the Bradford Ave. School in Placentia, Calif., not far from Los Angeles. The girders and the supporting columns, which also are hollow, form a series of five rigid-frame bents 26 ft. high to the bottom of the girders and spaced about 18 ft. apart. The span is 77 ft., and the floor plan of the auditorium is 77x127 ft. The general idea of the hollow frame design was patterned after structures of this type used in bridges of the Pacific Northwest as described in *Engineering News-Record*, Nov. 5, 1936, p. 637.

Concrete girder spans of 77 ft. are not uncommon in southern California; in fact, there are many of greater length, but all such girders are of considerable depth and have solid webs. The hollow girders in Placentia are the first to be used for building purposes, so far as the author knows. They have thin webs of varying thickness and 6-in. top and bottom slabs. The top slabs are cast integral with the intervening roof slabs to form a horizontal diaphragm designed to transmit seismic forces into the surrounding walls and thence to the foundations. Varying in depth from 5 ft. at midspan to 4 ft. at the ends, to provide roof drainage, the girders have an over-all width of 4 ft. 7 in. which is also the width of the columns. All five frames are carried on continuous footings running the full length of the side walls. The girders and the columns form a part of both the exterior and interior architectural design of the building. With the exception of the roof deck portion, the concrete was cast in plywood and run-mold forms, and will receive two finish coats of cement paint. There will be no plaster finish.

The top of the girder is flush with the top of the roof slab which, with the width of girder used, has a clear span of 13 ft. 2 in. between girders. Thus, approximately one-fourth of the roof area is carried directly by the girders. Loading over the remainder of the roof is transmitted to the girders by intermediate concrete joists. The layout of the roof framing is such that loads on the girders are symmetrical about their longitudinal axes and all girders have equal loads. Columns are identical except for a variation in the depth of the haunch below the bottom of the girder. This variation is the means whereby the architectural design is adapted to the sloping floor and to the varying height of the windows above the floor level.

Each half of the girder (assuming the complete girder to be split on a vertical plane through the center of the cross-section) was designed as a separate, independent channel-shaped member although no physical separation of the two halves exists. In fact, a fundamental aim of the design was to unite the top and bottom flanges and two webs by means of (1) numerous transverse diaphragms, (2) four interior fillets and (3) continuity of reinforcement.

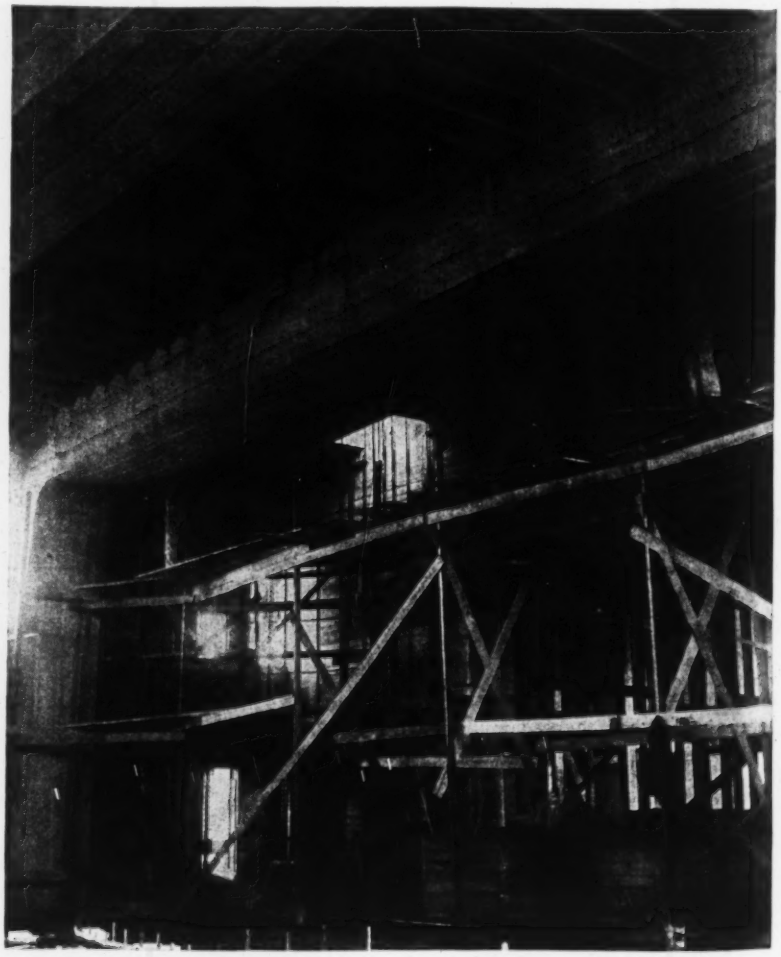


FIG. 1—FINISHING one of the hollow-member rigid frames in the Placentia, Calif., school auditorium. Concrete joists fit into keyways in the top of the frames. Architectural markings on girders will be accentuated when cement paint finish coat has been completely applied.

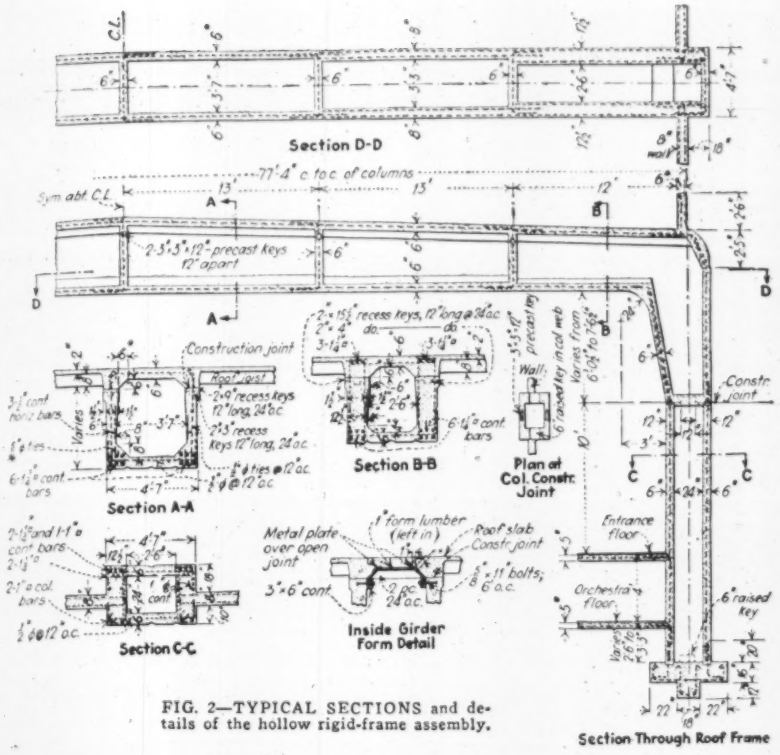


FIG. 2—TYPICAL SECTIONS and details of the hollow rigid-frame assembly.

Although the girder thus formed is relatively light for its bulk, it possesses a greater resistance to transverse rotational moments than does a conventional solid girder.

A substantial reduction in dead load and in dead load moments was effected by reducing the thickness of the webs or stems from a maximum at the ends to a minimum at midspan. These thin stems are effectively braced by the 6-in. top and bottom slabs of the girder and by the diaphragms. The stem thickness changes at the diaphragms which are spaced 13 ft. on centers. Six inches was chosen as the minimum stem thickness to be used in the two midspan panels, while the other panels were made 8 in. and 12½ in., respectively, to give the necessary strength nearer the columns.

The stems at the support were made of a thickness such that the compressive stresses were held well within the required limits even when the bottom slab area was ignored. This allowed the box section to be designed without a stiffening diaphragm at this point, eliminating a difficult forming and concrete placing problem. Web reinforcement in the stems was put in to meet shear requirements with the exception of the two center panels where nominal temperature reinforcement of ½-in. rounds on 12-in. centers was used.

The stems also vary 1½ in. in thickness from bottom to top as a result of an inward slope on their inner faces. A narrow corbel strip on the outside of each stem at the juncture of stem and top flange is provided to develop the horizontal shear through the construction joint. This shear is maximum in the section nearest the support but is sufficient throughout the girder length to require the extra concrete area. If the top flange and stems could have been poured in one operation, the extra concrete section and keys made therein would not have been necessary. These keys are designed for a maximum horizontal shearing stress of 148 lb. per sq.in. and are formed so that one-half of the stem area is depressed 2 in. with an additional depression 2 in. wide in each key to transmit seismic force from the weight of the girder, acting normal to the girder axis, into the roof slab diaphragm.

At the four inside corners of the box section, 6-in., 45-deg. fillets are used to strengthen the section at the connection between the stems and the two slabs, as well as to incase the main tension reinforcement at the bottom of the girder. Six 1¼-in. square, deformed, steel bars, 78 ft. long, extend the full length of the girder, since splices would have been difficult in this steel because of close clearances in the forms.

Column details

The sides of the columns are made 12½ in. thick to match the girder stem section at the supports; inner and outer faces are 6 in. thick. The inner face slab carriers the architectural treatment of the girder soffit down to the auditorium floor level. The main reinforcement in the column is located in the thick side sections (Fig. 2).

The frame was designed so (1) the columns could be poured to the bottom of the haunch; (2) then the haunch together with the bottom and sides of the girder could be poured to the underside of the roof or top slab; and finally (3) this top slab could be poured to complete the frame. A keyed, horizontal construction joint is provided at the bottom of the haunch to transmit the horizontal shear from girder to column. A similar key is used in the top of the footing at the base of each column.

In calculating stresses in the frames, provision was made for a shrinkage in the concrete by using a factor of 0.0002, equivalent to a temperature drop of 33 deg. F. This amounts to a shortening of the girder span by 0.186 in. In addition, because of the rigid frame and compressibility of the soil, an outward displacement of 0.2 in. was calculated at the base of each column. Risk of this lateral deflection at the footings was reduced, however, by adding a key 12-in. deep on the bottom of the footing, which decreases the horizontal soil pressure to 770 lb. per sq.ft. The design contemplated that these footings would be poured against undisturbed soil at the sides. The bottom of the footings is carried 5 ft. below the surface where there is but little moisture in the soil.

A camber of 3 in. is provided at the center of the span to take care of any deflection which may occur, and still leave enough camber for good appearance. Specifications for construction of the girders required that footings for the roof shoring be either timber or concrete, at least 12 in. below the natural grade level, backfilled to avoid excess of surface water contacting the bearing soil. These footings were required to be able to support 2,000 lb. per lin.ft. of girder at a soil pressure of not more than 1,000 lb. per sq.ft. Under these conditions it was estimated that the amount of vertical deflection during construction would be slight. Settlements varying from ⅞ in. as a minimum to 1⅛ in. as a maximum were measured after all concrete was poured.

Construction

Two lines of 8x8-in. post shores were located under each girder; the spacing was 11 ft. on centers on each line. Allowance was made in the post height for the take-up in the joints. Post footings were concrete piers.

The sides of the footings and the bottom key were required to be formed in undisturbed earth. Under this plan, footing concrete could be poured against the earth and thus assure full side bearing against the soil. In the clay foundation there was no difficulty in meeting this requirement.

The continuous footings were poured first, then column steel was erected and

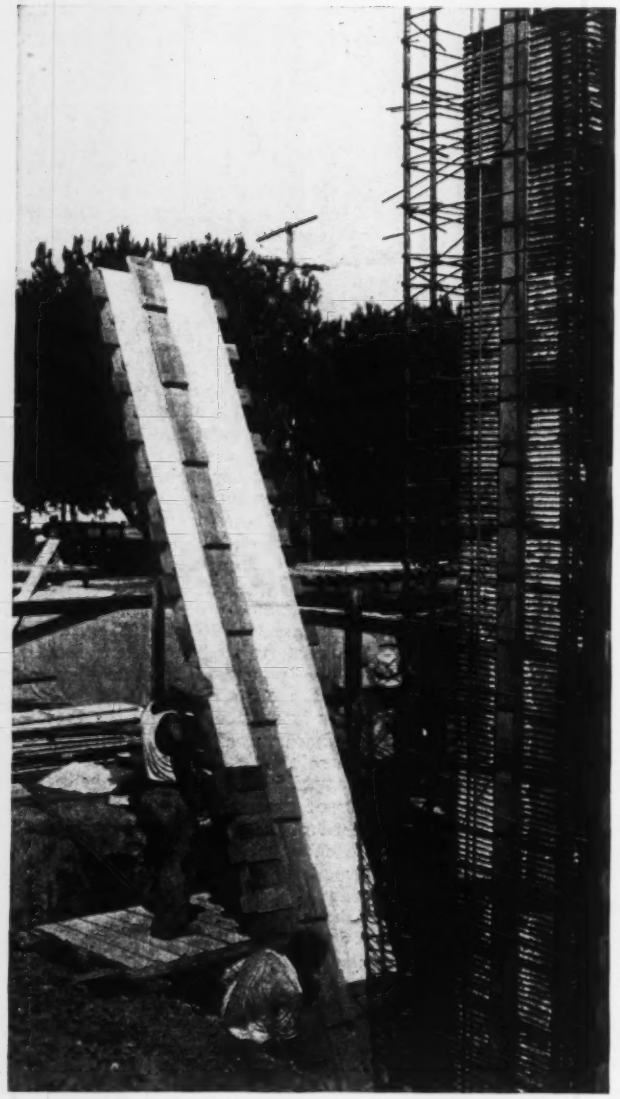


FIG. 3—ERECTING an outside form panel for one of the hollow columns. Interior forms are composed of metal floor pans piled one on another.

the interior form was placed. This form was made up of two sets of 24-in. metal floor pans with a wood spreader to give the required dimension. The column side forms were constructed to the bottom of the haunch with keyways to receive the intervening sections of panel walls, which were to be poured later. The columns were poured five per day, those on one side of the auditorium constituting a day's work. Panel walls were formed and poured in two lifts for convenience in locating construction joints.

With the bottom or soffit form and one side form of the girders set, placing of the 78-ft. reinforcing bars in the girders was started. The bars were run up an incline on rollers to the top of the deck and then were swung into place by hand. With the bars in place, exterior and interior forms of the girders were erected up to the construction joint under the roof slab. No form was provided for the top of the soffit slab which was poured directly from above.

After three days the interior side forms were removed, and forms for the undersides of the top slab were put in place. These forms could not be removed, and remained permanently within the girder. To prevent risk in case of side expansion of the form boards, a gap, covered with sheet metal, was made at the junction of the fillet and top form as shown in Fig. 2.

As no provision had been made for cleaning the inside of the girders after the inside forms were stripped, it was necessary to cut a small hole through the bottom of each 6-in. cross diaphragm to let the accumulation of water in the box section run to the outside walls. Another hole was provided through the outside face of the columns at the base of the haunch to let the water out of the section.

When the forms were set, the elevation of the bottom of the girder soffits at the centerline of the building was established. The accompanying table gives deflections during construction.

TOTAL DEFLECTIONS MEASURED FROM SOFFIT FORMS BEFORE POURING

Girder	After Pouring Soffit (in.)	After Pouring Roof Slab (in.)	After Stripping Forms (in.)
1	No reading taken.....	1 1/16	1 3/8
2	No reading taken.....	1 1/16	1 1/2
3	5/8.....	7/8	1 5/16
4	3/16.....	15/16	1 3/16
5	No reading taken.....	7/8	1 1/8

Specifications called for 6 sacks of cement to the cubic yard of concrete. Based on dry, loose volume, the mix was: 40 per cent sand, 2 per cent asphalt sand, 58 per cent 1-in. gravel, 94 lb. cement, and 6¾ gal. of water per sack of cement. Including the free water in the aggregates, this mix gave a slump of 6 to 7 in. The required 28-day compressive strength of the concrete was 2,500 lb. per sq.in. The working stresses in the girders were 938 lb. per sq.in. for the concrete and 16,000 lb. per sq.in. for reinforcing steel. The 28-day strength, as indicated by ten test cylinders, ranged from 3,050 to 4,320 lb. per sq.in. and averaged 3,567.

Drawings and specifications for the building were prepared by T. C. Kistner, architect; the writer made the structural design. Homer Scott, concrete technician, was resident inspector for the school district and for the architect. C. L. Wurster was the general contractor. The contract cost was $70,200 exclusive of heating, stage electrical equipment and seats, which gives a cost of $6.58 per sq.ft. or $0.23 per cu.ft. The job was completed Feb. 26, 1937.

Who Should Serve on Planning Boards?

Whether state and city planning boards should be composed in part of representatives of specified professions or of civic-minded, lay citizens without special training, is still a question in the practice of this comparatively new governmental function, according to Walter H. Blucher, executive director of the American Society of Planning Officials.

A bill introduced in the Michigan legislature for a permanent state planning commission prescribes that the personnel be made up of the state highway commissioner, the director of conservation and five additional members. The suggestion has been made, says Mr. Blucher, that the bill should specify as the additional members citizens representing professions such as civil engineering, landscape architecture, city planning and architecture.

In the opinion of Mr. Blucher, naming the exact professions that should be represented in the citizen-membership of a planning board does not safeguard against possibility of political appointments to the jobs, which pay in prestige rather than salary in most cases. In Michigan, he points out, the professions suggested for representation omit the sociologist, economist, and political scientist, who have contributions to make as important as those of designers.

As an example of effective planning where no provision has been made for the kind of professions represented by citizen-members, he cites the state planning boards of Oregon, Tennessee and Massachusetts, each of which has nine members. Massachusetts names three state officials and provides for six citizen members.

Letters to the Editor

Financing Flood Control

Sir—The very able article on stream control by A. E. Morgan in a recent issue of *Engineering News-Record* will surely have been read with keen interest by large numbers of engineers and public officials. If the principles there outlined are borne in mind by the planners of stream control on a national scale, there is little doubt that a splendid accomplishment will result.

Among engineers there surely is no argument as to the enormous importance of this development. Streams, large and small, must be controlled in the interests of flood prevention, navigation, power production, irrigation and the prevention or cure of stream pollution. Thousands of dams and reservoirs, canals, levees and water and power lines must be constructed and many existing channels improved or realigned. The necessary expenditures will be very large, but when the objects above enumerated, or such of them as are feasible for the locality, have been attained for any river valley, the desirability of the region for commerce and manufacturing, agriculture and related industry and as the site of homes and schools will be greatly enhanced. The resulting increase in property values will in no long time pay the cost of the improvements in the forms of direct and indirect tax returns.

In the meantime, how is this vast project of stream control to be financed? The federal government is the only entity great enough to contemplate the plan as a whole, for its execution will require a quarter-century and the expenditures will certainly run to billions of dollars. Federal agencies are, properly enough, making plans and studies for stream control in the river valleys of the entire country. The ultimate result, we may reasonably hope, will be a unified plan, the various elements of which will support and supplement one another and confer on the various sections proportionately equal benefits.

But there are grave objections to such a wholesale extension of federal power and activity. There is danger of the political element becoming effective in the choice of sites and projects and also of the academic and impracticable choices which are sometimes the result of distant, bureaucratic control unchecked by local knowledge and experience.

Fortunately we do not have to reason out this question from its beginnings or to resort to costly and perhaps disastrous experimentation. We have an example of proved success in a field closely related to regional resource conservation—that of our federal-aid highways. The central idea of that system is that of sharing the cost of local improvements which will result in benefits of a regional or national character between the state and federal governments approximately in proportion to the expected benefits. A highly important policy of this cooperative activity is that of requiring competent engineering control under state authority, but in accordance with a national plan, and another that specific projects shall originate with the states and not with the federal bureau.

An essentially similar system could be developed for the greater enterprise of country-wide stream control. This would largely eliminate log-rolling and the pork barrel, and would fairly well ensure the selection of projects of local importance and practicality. Projects would not be undertaken unless they promised both regional and national betterment. The competitive contract system would tend to efficiency and economy.

B. G. MARSHALL

Berkeley, Calif.,
March 31, 1937

Believe in Signs!

Sir—There has been a lot said about safety on the highways and chances are pretty good that there will be a lot more said about it, but here's something most people never think of.

How many times have you seen a bunch of men working on the highway with shovels, or maybe one had a red and white pole and one man was standing beside a funny-looking gadget that had three legs (and probably cost over three hundred dollars) while a couple more had a shiny tape in their hands. What did you do? Slow down easily, pull over to the far side of the road, being careful not to get tangled up in that shiny tape, and get as far as possible from that three-legged gadget. Well, then, you're different. Lots of people don't. They come just as close as they can, kinking the steel tape, throwing the instrument (the three-legged gadget) out of line and off the level, and cussing anybody that's damn fool enough to get out in the middle of the highway. And I've no doubt that quite a few of the readers of this little sketch are guilty as hell. Just think back to some of those trips last summer when you were in a hurry, and remember—

Last year in the Yellowstone National Park, two Bureau of Roads engineers were seriously injured; another had a shovel whipped from his hands, while dozens were chased clear off the road while working. This, I'm sure you will agree, is not at all conducive to good work and clear thinking. Just try to figure out your income tax in the middle of a busy street some time and you'll see what I mean.

In the summer of 1934, a highway location party was making a survey of a proposed road change in the western part of Wyoming. One morning they were measuring a narrow cattle pass, over which the road then ran, at the bottom of a small depression between two hills. Suddenly, and at the same instant, a car swept over each hill, and without slackening speed, roared down upon the startled and helpless surveyors, who barely had time to fall off the shoulders of the embankment. The cars met exactly on the cattle pass, and to this day no one knows just how they kept from wrecking. But they wheeled merrily on their way, the drivers probably thinking it was a grand thrill.

The coming summer will see a lot of highway work going on in many states and National Parks; lots of men on the roads. So what if you do average 69.4 miles an hour between Pumpkin Center and Brown's Forks? Where's the percentage? Unless thinner tires and lower gasoline mileage mean percentage to you.

And just bear this in mind: Insurance checks are nice to have, but somehow, they don't quite take the place of brothers and husbands. So take it easy. Whenever you see the sign, "Men Working," *slow down!* There's no bounty on surveyors.

E. A. MULLEN
Internal Revenue Service

Cheyenne, Wyo.
March 30, 1937

Illinois Group Opposed to Contractors' Insurance Companies

IN the March issue of its journal, *Public Construction News*, the Illinois Contractors Association endorses an editorial entitled "Stick to Your Knitting" published in *ENR*, Feb. 25, 1937, p. 311. The Illinois group expresses its opposition to contractors setting up their own insurance business as follows:

"The primary interest of contractors is that of construction, and it is a job of considerable magnitude to make a success of it without delving into insurance, bonds and other side issues. We very well recall the day when members of the industry were considerably 'hopped-up' over the possibility of contractors forming a bonding company to take care of their needs. Very properly, we think, the issue fell by the wayside. Those who are most interested in this activity are very largely contractors who by their own negligence or indifference are obliged to pay excessive rates. What contractor in his right mind wishes to band with such a group as this with the thought of improving his position?"

From Job and Office

Field Plotting and Stadia Topography Give Speed and Accuracy

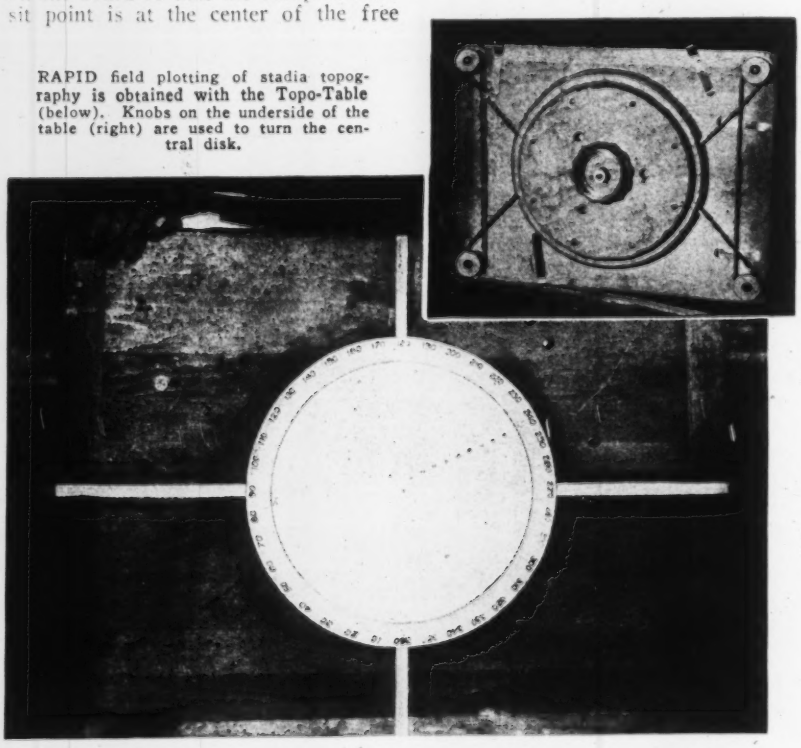
Paul Van Buskirk
Civil Engineer, Detroit, Mich.

A SIMPLE instrument for field plotting of transit and stadia topographical work is being used to good advantage on a WPA survey of the port of Detroit. It had been planned to use a planetable for the survey, but since no planetable men were found available on WPA forces it was decided to use the new instrument, which had worked successfully on some small farm surveys.

The device, known as a "topo-table", is a 20x26-in. tripod-mounted drawing board, in the center of which is a 5-in. radius white celluloid azimuth protractor; rotating inside the protractor is a white celluloid disk with a map scale engraved on one radius. All surfaces are flush with the surface of the board. The central disk is turned by knobs on the underside of the drawing board, as shown in the illustration.

In operation, the topo-table is set up near the transit, roughly leveled and oriented. A tracing cloth or vellum sheet on which all known controls and a meridian have been drawn is fastened on the board so that the occupied transit point is at the center of the free circle and the sheet is oriented with respect to the meridian engraved on the board. The transitman calls the azimuth of the first shot; the topographer rotates his scale to that reading and makes a dot at the proper distance as called by the transitman, using the dot as the decimal point for the elevation figures. The topographer is able to plot shots as fast as the transitman can read them and still have time to draw in trees, fences and buildings. When a new station is set, its position is plotted like any other shot, or graphically triangulated. When the new station is occupied, the drawing paper must be shifted to bring the new plotted position to the center of the board.

Tracing cloth sheets are very satisfactory for field work. The recently developed pencil tracing cloth can be obtained in a quality that will take 5-H pencil, erase cleanly, and not smudge easily, is highly transparent and makes a permanent record. A simple prestretching treatment eliminates nearly all tendency to buckle on damp days. A cardboard tube is used to protect the sheets from crushing.



RAPID field plotting of stadia topography is obtained with the Topo-Table (below). Knobs on the underside of the table (right) are used to turn the central disk.

The mapping is being done at the customary scale of 200 ft. to the inch. Section and quarter line control is plotted on muslin mounted paper, and the thousand foot grid lines are all drawn. Using an 18-in. square field sheet, four grids and all control lines are traced in pencil on the rough side, then inked in fine lines on the glossy side. Point to point azimuths are shown in the same manner. Only these four grids are mapped.

Field work on a sheet takes four or five days, and the sheet comes back to the office very clear in the mapped area. Mapping near the edges of the cloth proved to be false economy, as keeping the sheet in the field too long results in messy work. The original field sheets are not inked. They are traced one at a time on a master sheet or transferred to the base sheets by the pencil carbon paper method.

We have found it possible to get legible red line non-shrinking prints direct from the penciled field sheets. These prints are trimmed to the co-ordinate lines, matched, and fastened together with transparent scotch tape. This gives an excellent check on completeness and accuracy and also stimulates the topographers to do neater work.

The method has proved most satisfactory. Quality of the work is as good as we expected to get from the plane table method and the rate of production has exceeded that of an expert plane table man on similar terrain. An average of an acre per man per hour in the field, or twenty acres per day for all weather is maintained. The fact that the device can be operated successfully inside a car reduced the lost time item a great deal.

The survey is being done as a WPA project, under H. S. Bedell as project director and the writer as engineer of surveys.

Concrete for Conduit Invert Placed Under Steel Slip-Front

IN CONDUIT SECTIONS of the Los Angeles aqueduct it is customary to pour concrete in the invert first and later to pour walls and arch as a separate operation. Instead of the usual tamper and screed for placing invert concrete, experiment has been made with invert-placement equipment known as a slip-form. This has worked out so well that it has come into quite general use in conduit sections.

As developed by Three Companies, Inc. on Division 3, the slip-form is a device for receiving, spreading and finishing concrete. Spanning the invert are wood, and steel trusses carrying two hoists driven by variable-speed motors.

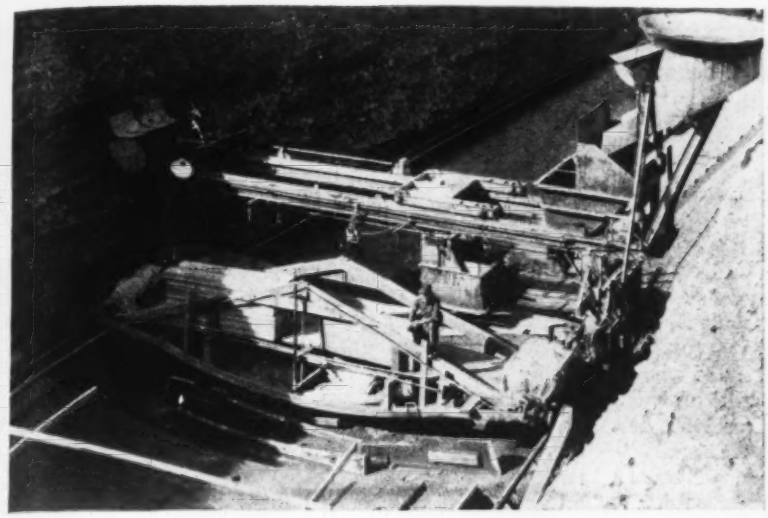


FIG. 1—THE INVERT SLIP-FORM. At the right is the concrete hopper and storage bin. Concrete passes to the car that travels across the invert along the advancing edge of the form. Form parts are lying on the finished surface in the foreground.

one on either side of the invert. The motors advance the form slowly over the prepared subgrade at the same time forcing down into place the concrete which is fed through an open-bottom trough along the forward edge of the form. Delivery to the trough is by a bottom-dump car moving across the invert on rails carried by the overhead truss. This car receives concrete from a hopper at one end of the truss and distributes it evenly in the trough spanning the invert.

Placement by this method is economical, and the surface of the concrete, pressed down by the form passing over it, is left in a fairly well-finished condition. Because the slip-form constantly is moving forward, finishers who work the concrete surface by hand have access to their work while the concrete is still very fresh. So little hand finishing is required that two men working on a bridge that spans the invert immediately behind the slip-form can give the surface a hand-finish of very high grade and keep up with the machine, which moves ahead at about 1 ft. per minute.

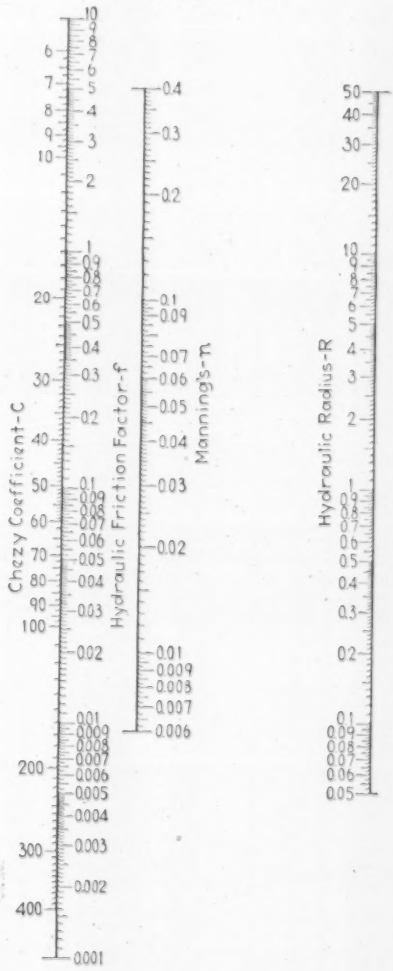
The Colorado River Aqueduct is being built by the Metropolitan Water District of Southern California. Frank E. Weymouth is chief engineer and general manager.

Nomographic Relationship of Hydraulic Friction Factors

By Wm. H. Overshiner
Ass't Engineer, Orange Co. Flood Control District, Santa Ana, Calif.

IN DEALING with hydraulic problems involving the flow of water through pipes or conduits one of several formulas may be used. Among the more common are the Chezy formula which involves the coefficient C, the Weisbach formula which involves the coefficient f and the Manning formula which involves the coefficient n.

FIG. 1—RELATION of the hydraulic factors, C f, n and R.



It occasionally becomes necessary to know the value of one of these coefficients corresponding to that of another. For instance tables of values of C or f may be available for given conditions and it is desired to know the corresponding value of n for use in the Manning formula. The relation of these three factors is expressed by the following two equations:

$$C = 2\sqrt{\frac{2g}{f}} \qquad C = \frac{1.486\ R^{\frac{1}{6}}}{n}$$

which are readily obtained by eliminating V from the original three formulas.

The nomograph which has been constructed gives a ready solution of the above two equations for all cases likely to be met with in practice and at the same time gives a visual idea of how these factors vary among themselves.

As an example of the use of the nomograph let it be assumed that a 48 in. new cast iron pipe is to carry a quantity of water flowing at a velocity of 3 ft. per second. The value of f for these conditions as given in Russell's *Textbook of Hydraulics* is 0.0160. It is desired to know the corresponding values of C and n. Since the hydraulic radius R is 1.0, a triangle is laid from this point on the R scale to the point 0.0160 on the f scale. Values of C and n may then be read on their corresponding scales as 127 and 0.0117 respectively.

Tokio Plans Completion of Sewer System

TOKIO plans the completion of its sewer system before the Olympic Games are opened in 1940, according to the official *Domei* news agency. Construction of sewers in this city was started more than 50 years ago but the extensions have not been rapid and most of the area of the city still depends on the "gomitori," or dung-pit man.

Generally speaking, sewer installations are lagging far behind the general advance in civil engineering works in Japan. Last year a survey revealed that only 24 cities and one town had complete sewerage. To correct this situation, the Japanese government is granting a subsidy of one-third of the construction outlay, the prefectural government provides another third, and the balance of the cost is borne by the municipality. At the present time, 20 cities are building systems, of which the Tokio project is one.

The combined system of sewers is widely used in Japan, and most cities discharge sewage directly into canals, rivers, or into the sea. Tokio, however, treats its sewage in a sprinkling filter plant, and the city of Osaka recently completed an activated sludge treatment plant.

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April 15, 1937

Old Trade Routes Revived

THE GOVERNMENT land surveyor who marked the western territories into shapely squares for farm settlement was a poor highway transport engineer. Road location was not his business, and when he had reserved for travel a strip one chain wide around each square he had done his duty as a road planner. It was poor planning for highway intercourse extending beyond a dozen miles; but fortunately the pioneer trade routes had preceded, and they remain to preserve modern through travel from the zigzag routes of the land surveyor. These pioneer diagonals still mark main traffic routes in many western states, and their rectification and extension are vital problems in state highway planning. As outlined in this issue Michigan is one of the states that is doing this work. A complete diagonal and shoreline road system will in a few years give through roads between all its ports and interior trade centers. In the field of planning for through transport, this Michigan work stands out notably.

Unified Road Laws

IN CODIFYING ITS HIGHWAY LAWS dating back to pioneer days the state legislature of Washington has performed a task that many states need to carry out if system development is to keep step with transport needs. Highway engineers will observe with interest the detail provisions of the new law as summarized in our news pages this week. Opinion as to the merit of many of these provisions will vary, but the purpose and spirit of the new statutes can expect general approval. They assemble into a convenient code a multitude of acts pieced together during three-quarters of a century, and they hold state road funds and their control in system development under central authority. Weak details as they appear can be strengthened simply enough if the basic constitution is sound, as the legislators of the new code believe it to be. The state of Washington is to be congratulated on its successful effort to unify its highway legislation.

Good Counsel

A SANE WORD on educational methods, especially pertinent to current problems of engineering education, comes to notice in an address by Hardy Cross before a section of the Society for the Promotion of Engineering Education last spring, recently published in the Society's journal. Prof. Cross says that it is teaching that counts, not curricula, and that all of the new developments in engineering education would fit quite as well into the curricula of thirty years ago as they do into the more modern ones. The truth of this remark will be recognized by anyone who recalls the splendid work done by our best technical schools thirty and more years ago—the result of sincere, conscientious and inspired teaching more than of highly organized curricula and elaborate equipment. When Prof. Cross says that great buildings and fine laboratories cannot make a great university, but that great teachers do, he gets down to a fundamental principle that engineering colleges will, we hope, never leave out of mind. It is worth remembering, too, that a similar truth applies to the mystic operation of "raising the status of the engineering profession"—its progress depends less on organizing, publicity, bootstrap pulling, than on the personal influence of great engineers.

Pollution Abatement Progress

ADDING THE FIRST SPECIFIC DETAIL to the oft-repeated statement that sewage treatment has made great progress during recent years, statistics collected by the Public Health Service and this week reported by a federal Water Pollution Committee show a remarkable picture. In the short space of five years the population served by treatment works has been increased by three fourths—in 1932 some 2,900 plants handled the wastes from 19,500,000 people, while today 3,700 plants (in operation or under construction) serve more than 35,000,000 people. Principal credit for the increase goes to the PWA, which aided by far the greater number of the new plants. Yet the ultimate objective of pollution abatement remains distant. A second five-year program would bring us measurably nearer to the goal, at a cost of about half a billion dollars. How far the federal government can be expected to participate in this expenditure may fairly be questioned, but even without such aid the accomplishment is not impossible, in the light of normal municipal sewer expenditures.

Half a Job

CONSTRUCTION IS AN UNKNOWN INDUSTRY. Great and wide-spread are its activities, yet complete and specific information concerning it is lacking, to the detriment of the industry itself and to the country at large that depends so much upon construction for business and employment. When the government announced a census of construction in connection with the 1935 census of business, it looked as though at last we were to learn something about our industry. These hopes were soon dashed, however, when the census was so limited as to omit all government day labor operations, all of the construction carried out by large industries and utilities, and all of the heavy maintenance work that approaches new construction in importance. Even the contracting business was not covered fully, for no attempt was made to secure information on the equipment and material used. Nevertheless the census did produce valuable figures, for the 75,000 firms and individuals which carry on contract work in 1935, employed over 400,000 persons and paid out a half billion dollars in salaries and wages. The data given in a summary of the census in this issue, show that, though unfortunately only half a job, the census was a good job as far as it went.

To Fix or Not to Fix Prices

DESPITE THE importance of the question at issue, the complaint of the Federal Trade Commission against cast iron soil pipe manufacturers cannot be taken seriously. Essentially the complaint is an attack on the basing-point system of listing price quotations of staple articles. While there is weighty objection to this system because of its inequities, neither the government

nor industry itself has done a real job in finding an acceptable substitute. Market quotations are inseparable from standard products; they will establish themselves automatically. Moreover, the desirability of such quotations has had governmental recognition. While prices of such products as breakfast cereals or razor blades generally are uniform throughout the whole country, heavy products are not adapted to such uniformity and in consequence their price quotations recognize either a single market center or a multiplicity of markets or basing points. Because of the serious objections to a single basing point such as is used for soil pipe, multiple basing points are widely used. Nevertheless the Federal Trade Commission itself has repeatedly denounced the multiple basing-point system. In other words, just what is an acceptable quotation or price system is left quite undefined. If the Commission or other competent authority will point out how an effective, stable and lawful price-quotation system can be set up, orderly business will be enabled to make headway in working out its problems. Until then the Commission's complaints and prosecutions serve no useful purpose except in the few cases where monopolistic collusion is found.

River Resource Management

RIVER PROBLEMS have emerged so definitely into the field of vital public interest that it is difficult to overvalue what was accomplished in last year's drainage-basin survey, reported in complete form this week. The first part of the report was published two months ago, but it was buried in a mass of extraneous discussion by the National Resources Committee on how to carry on public works, and thus was largely kept from public knowledge. For this reason the clear and compact summary (ENR April 1, 1937, p. 476) prepared at our request by the organizing head of the work, Abel Wolman, performed useful service in giving a picture of the purposes and results of the undertaking. The full report now at hand amplifies this picture with much detail.

There is reason to believe that when the Administration asked for the survey it expected to obtain a ready-made program for a national construction campaign, and the survey has in fact been publicized by the Administration as setting up such a program. However, no one familiar with river problems and with four or five prior attempts at comprehensive steam study—the 308 army investigation begun in 1927, the Water Flow Committee study in 1933, the Mississippi Valley Committee work in '33 and '34, the Water Planning Committee's countrywide reconnaissance in '34 to '35—would fall into the error of believing that the survey produced such a result. The report now at hand reveals what it actually accomplished.

The survey is a listing of improvement projects that affect river use or abuse, and in addition a partial sifting and coordination of these projects. Because of the short time available for the work the listing is incomplete and the appraisal and coordination of the projects quite general in character. The report is to be regarded as a preliminary index of future river-development problems and undertakings. As such, however, it is a highly instructive and useful document.

The importance of the subject matter is obvious. Flood, drought, stream pollution, the needs of water supply and irrigation, as well as latent power possibilities, all have direct bearing on the public interest. Recent experience has been a convincing teacher as to the far-reaching effects of river conditions, and in consequence most problems of amelioration or public improvement are now recognized as being interlinked with river development. Our future dealing with such problems undoubtedly will tend more and more to be guided by comprehensive drainage-basin study and coordination. The present survey, the first comprehensive basin-wide consideration of river matters, therefore sets a milestone in our river history.

In detail the survey is by no means a balanced piece of work—for natural reasons. Two river problems are specially prominent at present: flood hazards and the fouling of streams by sewage and industrial wastes. Both have been investigated intensively, the former by army engineers, the latter by state health boards. Projects in this field, therefore, bulk large in the survey lists and maps. Later on, water conservation and supply will require similarly detailed study, and this will add many other projects to the present lists and may call for reconsideration of the present projects from the viewpoint of balanced and efficient stream-basin development. It is evident that, while the present survey forms an excellent starting point, a great amount of further study will be necessary before any individual projects are ready to go ahead.

Both in this study and in the subsequent prosecution of river projects, cooperation of federal and state authorities will be indispensable if the best joining of purposes, knowledge and power is to be attained. As yet no general method of cooperation has been proposed; probably no single method would prove feasible or desirable in all cases, but different plans of procedure will be needed for different basins. In fact, cooperative action in one form has begun on the Red River of the North, and other forms are being worked out for the Potomac, the Ohio and the Connecticut; each basin presents conditions of its own. In each instance, however, while federal cooperation is important the local interest is so obviously dominating as to make it urgently important to avoid federalizing the work. We should preserve the fullest measure of state jurisdiction and responsibility compatible with administration of a water network extending throughout the nation.

In sum, the drainage-basin survey points to two major conclusions. First, intensive study of each basin and each problem in that basin must follow the present survey, before specific project planning and construction can be undertaken; the survey has made a beginning, but only a beginning. Second, sound conduct of the work requires that a means of continuous correlation of state and federal authorities be established. No adequate agency for the purpose exists today. The National Resources Committee, which seems to have been conceived as such an agency, has not proved itself sufficiently practical to win popular approval as water coordinator. The Water Resources Committee, which conducted the survey in highly practical manner, lacks the necessary autonomy and organization for continuous service of the type required. A permanent bureau or board comparable to this committee should therefore be set up, operating under a code of objectives and principles laid down by Congress. The establishment of such agency and code is essential to national progress, for if we are to protect and develop our vast river resources a faithful and competent representative of the nation's share in these resources is indispensable.

CURRENT NEWS

Markham Endorses Florida Canal

Gen. Markham testifies before House Committee hearings on Florida ship canal explaining his favorable report

First witness to appear before the House Committee on Rivers and Harbors at its hearings on the Florida ship canal was Major-General Edward M. Markham, Chief of Engineers, whose favorable report on the project was the immediate cause of the re-opening of the question. He was followed by Malcolm Pirnie, consulting engineer, and Lieut-Col. Brehon Somervell, who has been connected with the project in several capacities, notably as a member of the President's special board of review and as head of the engineer district formed to initiate construction with $5,400,000 allotted from relief funds.

Gen. Markham's testimony, which continued over parts of three days, included a brief history of the project, an exposition of his report, and a discussion of the points of difference between his and previous reports.

History of project

Without attempting to detail the long and involved history of the project since Congress, in the Rivers and Harbors Act of 1927, directed a preliminary examination and survey, the general stated that his report was submitted in completion of the usual and normal procedure followed in the case of all navigation improvement projects. This process has been complicated by the intervening applications for RFC and, later, PWA, financing, and by the inauguration of construction as a work-relief project. Since the cessation of work the project has been reviewed by (1) a special revisory board of five engineer officers, which recommended completion of the canal at a cost of $157,585,000; (2) the Board of Engineers for Rivers and Harbors, which set the cost at $263,838,000 and failed to find economic justification for its construction; and (3) Gen. Markham himself, who "disagreed with everybody," finding economic justification for completion at a cost of $197,921,000. In each case cost figures exclude the $5,400,000 already expended, and in each case the controlling dimensions of the waterway differ.

Points of agreement

The three latest reports are in substantial agreement on the route to be followed, the amount of commerce that can be expected to use the waterway, the superiority of a sea-level, as compared with a lock-type, canal, and the value which the completed project would have to commerce. The latter computation is based upon actual Gulf-Atlantic traffic during 1935, without any attempt to project future increases. The revisory board estimates annual benefits at $9,553,000; the rivers and harbors board $8,543,000; the Chief of Engineers $8,741,000.

The major points of difference include dimensions, unit costs, amortization and interest charges, and annual maintenance. Of these, by far the largest dollar difference is due to varying estimates of the cost of hydraulic dredging in soft rock, upon which large-scale experience is lacking. It was pointed out by Gen. Markham that because of the quantities involved, a small difference in the unit price would mean a tremendous difference in total cost. The Ocala limestone through which a large part of the canal will run is of unusual nature. Of sedimentary origin, it is relatively soft and, although it will maintain shape and form, has no toughness and is easily shattered by explosives. The general told the committee that he had watched a large-scale blasting operation in a quarry near the canal line, in which a 70-ft. face was blown by holes on 12-ft. centers placed 18 ft. back from the face. Except for the upper 12-ft. section, the entire face was shattered and about half the rock was reduced, in the general's terminology, to "face powder."

This demonstration convinced Gen. Markham that large hydraulic dredges would be able to excavate 400,000 cu.yd. monthly, whereas the rivers and harbors board had estimated only 300,000. This

(*Continued on page* 572)

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Major Contract Advertised For Queens Tunnel

The New York City Tunnel Authority on April 14 called for bids on the largest contract yet to be awarded in connection with construction of the $58,000,000 PWA-financed Queens Midtown Tunnel. The work to be performed under this contract, estimated to cost about $18,000,000, includes the construction of the tunnel from the Queens construction shaft to the Manhattan construction shaft and also placing of permanent and temporary clay blanket over the river bed in the East River, removal of the temporary blanket, and construction of ventilation shafts at the Queens and Manhattan terminals of the vehicular tunnel.

In addition to the complete under-river construction of the twin tubes, the contract calls for erection of certain foundation piers; the completion of the Queens and Manhattan ventilation shafts; the construction of a temporary construction shaft at the Manhattan terminal; demolition of buildings; protection, support and maintenance of adjacent buildings and other property; relocation and restoration of surface and subsurface structures affected by the work; and maintenance of street traffic during construction.

The temporary clay blanket that will be laid over the river bed before tunneling starts will be as much as 40 ft. high and 450 ft. wide. It will contain more than 600,000 cu.yd. of selected clay, and it is said to be the largest clay blanket ever laid on any river tunneling job.

New Highway Code For Washington

State consolidates all highway laws in general code, increasing powers of highway director

A new highway code became effective in the state of Washington April 1 after having been passed by the state legislature and signed by Governor Clarence D. Martin.

The code consolidates all road laws on the statute books, dating back to 1854, and governs construction and maintenance of Washington state and county roads and city streets. It greatly increases the authority of the highway director, an appointee of the governor, requiring his approval on all projects financed in whole or in part by proceeds from the state gas tax fund.

The code was first presented in the state legislature two years ago under administration sponsorship, but was shelved for further study. When reintroduced in January, portions that had been objected to as giving the state too much power were eliminated.

The code is comprised of four separate laws: the state highway act, concerning highways directly under supervision of the state; the state-aid highway act, dealing with county roads and city streets not in the primary or secondary highway system; the license act, relating to motor vehicle registration; and the motor vehicle act, which sets up safety standards, limits speeds, and regulates reporting of accidents.

The director of highways, under the code, will handle the selection, construction and maintenance of all state, county or city roads and streets financed in part by federal aid. This embraces streets and roads not included on the state primary or secondary systems.

The state highway act provides that the director of highways must be a registered professional engineer and a graduate in engineering. If not a graduate, he must have had responsible charge of civil engineering work equivalent to such education and, in addition, not less than five years experience in road construction.

County commissioners will continue to have full control of county roads, "subject to direction and approval of the director of highways." Each county must appoint a county road engineer "who shall be a registered and licensed civil engineer . . . duly qualified and experienced in highway and road engineering and construction, who shall serve at the pleasure of the board."

Each county road engineer must furnish a bond to assure faithful performance of his work, and account for all property entrusted to his care.

The three counties of the first class in Washington—King, Spokane and Pierce—previously had elected county engineers. These engineers will continue to hold of-

(*Continued on page 572*)

CLEANING THE COLORADO

THE ROTATING ARM of one of 72 Dorr clarifier units to be installed in the desilting basin at Imperial Dam, which will head the All-American Canal now being constructed by the Bureau of Reclamation in southern California. These machines will relieve the waters of the Colorado River of their silt and in so doing, it is estimated, will save Imperial Valley irrigators $1,000,000 a year in the cost of maintaining their canal systems.

Cincinnati Abandons PWA Aid For Its Public Works

Acting as a result of the new PWA policy that federal grants for public works be proportional to the amount of relief labor used, the city council of Cincinnati has accepted a recommendation of its finance committee that the city proceed with its public works program without waiting for or seeking federal assistance from PWA.

J. E. Root, city public works director, stating that the city proposed to proceed on its own in the future, said that if the city went ahead without federal assistance private contractors could do the work cheaper than it could be done under the new Public Works Administration plan. City manager Dykstra, supporting the proposal before the councilmen, said: "It's up to you gentlemen to decide whether we are to go on our own on public works, as we used to do, or try to carry on a limping, halting, Public Works Administration program."

Two projects were mentioned in the finance committee's report, the $5,000,000 waterworks program and a $600,000 street improvement program. On the first of these projects, which would contemplate the expenditure of $3,000,000 for additional pumping station facilities and $2,000,000 for suburban water main construction, city manager Dykstra has already taken steps toward employing a consulting engineer with city funds. This action would have waited upon the receipt of a PWA grant under the city's former procedure.

It is planned to build the proposed new pumping station at the filtration plant, with a capacity of 20 m.g.d. in order to provide an auxiliary supply of water even if a flood should put the Eastern Ave. pumping station out of commission. It is felt that interconnection of all existing reservoirs and standpipes in the city may be necessary in connection with this plan.

Reletting Housing Contract Saves $121,000

Administrator Ickes has accepted the bid of the Central Contracting Co., Dallas, Texas, for construction of superstructures on Andrew Jackson Court, the $1,500,000 slum clearance and housing project in Nashville, Tenn. The company's low bid was $1,278,000.

Bids were first opened on construction of the superstructure last July and at that time the lowest bid submitted was $1,479,000. All bids received were rejected and new bids were taken. When these bids were opened Sept. 1, the lowest was $1,399,000. These bids also were rejected, (*ENR*, Dec. 31, 1936, p. 945) and the project was redesigned, increasing the number of living units from 276 to 398, and the present bids were called. The present award represents a saving of $121,000 over the lowest earlier bid and of $201,000 over the low bid on the first opening.

Foundation work on the project has been completed by the Bush Building Co. of Nashville. It is expected that construction of the superstructure, according to the new plan, will start immediately.

New Bill Introduced For Bonneville Power

Senate bill similar to House measure but puts rate-making under Federal Power Commission

Although markedly different in phraseology, a bill for the disposition of surplus power from the Bonneville project on the Columbia River introduced in the Senate jointly by the four Senators from Oregon and Washington on April 5 follows the general pattern set by the House bill introduced Feb. 19 by Representative Smith (*ENR*, Feb. 25, 1937, p. 312).

Principal point of difference is that the new bill subjects the proposed Columbia River Administrator to the supervision of the Federal Power Commission in the determination and modification of rates. The first bill left this entirely to the discretion of the Administrator. Also, the proportion of the project's cost to be allocated to power is to be determined by the Federal Power Commission, rather than by the Administrator.

Rates more definite

The formula to be used in determining rates is fixed somewhat by the provision that schedules shall be drawn up "having regard to the recovery (upon the basis of the application of such rate schedules to the capacity of the electric facilities at Bonneville project) of the cost of producing and transmitting such electric energy, including the amortization of the capital investment over a reasonable period of years."

Other minor differences introduced by the four Senators include: A requirement that the Administrator, upon being appointed by the Secretary of the Interior, must be confirmed by the Senate. Enlargment from three to four members of the advistory board with which the Administrator will consult, the fourth to be appointed by the Secretary of Agriculture (the other three, as before, representing the Interior and War Departments and the Federal Power Commission). Reservation of 50 per cent of the power until Jan. 1, 1940, for the benefit of public power distributors and co-operatives. The House bill specifies January 1, 1939.

Army operates powerhouses

The Senate bill also adopts the modification proposed by the Chief of Engineers placing the operation of the powerhouse, as well as the navigation facilities, in the hands of the Army engineers, who will deliver the surplus power to the Administrator at the bus bar.

Other sections of the two bills are substantially the same, with rate re-adjustments at intervals of not more than five years. Public bodies and co-operatives are given first preference in the sale of power, even to the extent of a five-year cancellation clause in contracts with private utilities if the power contracted for should be needed by them.

The question whether rates shall vary with transmission distance, or be uniform over the entire area served is left still undetermined by the provision that rate schedules "may provide for uniform rates or rates uniform throughout prescribed transmission areas."

Bonneville Profits Held Taxable

Oregon Supreme Court holds state may tax Bonneville Dam contractors, reversing previous decision

The Oregon Supreme Court has ruled that the state may collect income taxes from Guy F. Atkinson Co., contractor on the Bonneville dam. The decision reverses a decision of the same court handed down last November.

The Multnomah County court, in the case of Guy F. Atkinson Co. vs. the Oregon Tax Commission, had held that the profits of the contractors were taxable.

On appeal to the Supreme Court, the higher tribunal last November reversed the decision and held that the profits were not taxable since the work was performed on federal property with federal money. The present opinion brings the Oregon court into agreement with a recent Washington state court decision which decided a similar issue in regard to Grand Coulee and affirms the decree of the Multnomah court.

The total income taxes collectible under this decision from the Atkinson Co. and other contractors at Bonneville will amount to about $250,000.

The suit gained a rehearing on a petition from the state tax commission. A similar suit regarding Winton Bros., contractors on a Lower Columbia jetty, is now on appeal to the Supreme Court of the United States after having been denied rehearing in the state court.

"Our argument in rehearing this matter was practically limited to the question of whether the federal government has exclusive legislative jurisdiction over the site of the Bonneville Dam project," the majority opinion stated.

"It is apparent that the state of Oregon has power to tax any personal property belong to private individuals located on any of the navigable waters within the Bonneville dam project. Likewise any other power of taxation which the state has would be effective within that area."

The court concluded that the federal government has not acquired exclusive jurisdiction over the Bonneville area.

The dissenting minority opinion stated that, "if the law is stated correctly in the majority opinion, it would be impossible for the United States ever to acquire exclusive legislative jurisdiction over any lighthouse, jetty, dam or other instrumentality erected as an aid to navigation on land underlying the navigable waters of the state. Such a doctrine is not compatible with the dignity or sovereignty of the United States in acting within the scope of its governmental powers."

McKinnon Reinstated as Chief Of Montana Department

John A. McKinnon, who resigned Jan. 16 last from his position as chief engineer of the Montana highway department along with three other officials of the department, has been reappointed chief engineer by the new highway commission.

At the time of his resignation last January, Mr. McKinnon had been chief engineer for about a year and a half.

Thomas H. Jackson

Gen. Thomas H. Jackson Dies in China

Brig. Gen. Thomas H. Jackson, retired, former president of the Mississippi River Commission, died in China on April 7 while on a world cruise. He was 63 years old. Gen. Jackson, who has been in ill health for some time, retired recently from active service and in January started on a cruise with Mrs. Jackson.

Gen. Jackson is best known for his work of inaugurating the so-called Jadwin plan of flood control on the Mississippi River and directing that great operation through the years 1928 to 1932. Less well known but equally notable was his earlier work (1907-1911) in directing flood control operations on the Sacramento and Feather rivers in California as secretary of the California Debris Commission. In the Sacramento work, spillways were developed that became the prototype for Bonnet Carré spillway on the Mississippi.

Without doubt it was the record established on the Sacramento that led to the selection of Gen. Jackson as head of the Mississippi River Commission. He came to that task at the time when the method to be followed in protecting the Mississippi valley against a repetition of the disastrous flood of 1927 was the subject of a heated controversy between the Corps of Engineers, headed by Maj. Gen. Edgar Jadwin, and the Mississippi River Commission, headed by Col. Charles L. Potter up to the time Gen. Jackson was appointed to succeed him. Gen. Jackson's appointment automatically made him a member with Gen. Jadwin and Carlton W. Sturtevant of the special board set up by Congress to review and pass on the conflicting plans. The board recommended to Congress what is now known as the Jadwin plan and it was approved and authorized.

Gen. Jackson spent the following four years directing the work of putting the Jadwin plan into effect. In 1932 he was transferred to Norfolk, Va., as division engineer and two years later was returned to San Francisco as division engineer. In this assignment he became, automatically, president of the California Debris Commission. In 1936 Gen. Jackson was transferred to Washington to prepare a special report on flood control.

Massachusetts Refuses Payment For Overpass Repair

Attorney-general Dever of Massachusetts ruled, in an opinion rendered April 7, that neither the state nor the federal government was liable for payment to the Coleman Bros. Corp. of an extra charge of $65,000 for repair of the settlement Aug. 29 of the approach to the Jamicaway overpass in Boston (*ENR*, Sept. 10, 1936, p. 389).

The attorney-general pointed out that the construction of the overpass was performed by the state by means of a grant from the federal government which was not to exceed $390,380. Because of this fact, the contract entered into between the state and the Coleman firm was such that the contractors' total compensation could not exceed the amount forwarded by the federal government for the performance of the work. The exclusive source of payment for this contract was federal funds, and the contractor could not look to the state for payment. No provision for the making of amendments was included in the contract.

Stating that "it has been frequently held by our courts that a provision of a contract by which one obligates himself to look to a special source or fund for compensation is valid, and it has been consistently upheld," the attorney-general supported the action of state comptroller Murphy in holding up payment of a warrant for $30,000, which was part payment of the total amount of the extra.

The attorney-general expressed the opinion that unless the federal government makes a further allocation of funds for payment of the extra, the contractor has no recourse except to take suit against the state or to have a special act passed by the present session of the legislature.

Federal Pollution Aid Urged in Report

Urging a renewed attack on pollution problems, the National Resources Board has released a report outlining recommended legislation which will assure consistent and logical development of sewage disposal facilities. The recommendations were based on studies of the Water Pollution Committee, appointed by the Water Resources Committee, which show the remarkable progress of pollution control during the last four years as a result of federal financial stimulation through the TWA and the WPA.

While no basic changes in federal law with reference to regulation of pollution are suggested, the extension of federal interest and participation in local and regional pollution control measures is urged. The report recommends that new legislation should have the following provisions:

1. Designate a Federal agency to study and report on water pollution and pollution-abatement projects;
2. Provide for loans and/or grants to public agencies, and loans to non-public agencies for pollution-abatement works;
3. Provide that loans or grants be approved by an overlying public works agency;
4. Provide that loans or grants be cleared with a water-resources planning agency to

insure reconciliation of pollution abatement work with the comprehensive utilization and control of water resources in the drainage areas affected;

5. Give Congressional consent to negotiation of interstate compacts for pollution abatement.

Progress in sewage treatment

Progress in water pollution abatement during the past five years has been unprecedented, says the report. Approximately half of our urban population is served by sewage treatment plants. In 1932 only 31 per cent of the urban population was tributary to plants. This change marks an increase of more than 70 per cent in population served during a 5 year period, resulting in a great reduction in amount of raw sewage reaching surface waters annually. The rapid progress in sewage pollution abatement is due almost wholly to federal financial aid—720 of the 835 new disposal plants were built with federal funds. Much work however remains to be done. An expenditure of at least $500,000,000 would be required to provide treatment for the sewage from three-fourths of our estimated urban population in 1941. This estimate, however, does not provide for the very considerable cost which would be entailed for the construction of industrial wastes treatment plants.

Abatement of pollution from industrial waste proceeded less rapidly and less uniformly. In some industrial areas notable progress was made, in others the lack of economical treatment processes or inertia prevented any substantial reduction of wastes.

Gerald W. Knight Dies

Gerald W. Knight, recently appointed executive secretary of the Interstate Sanitation Commission by Governor Hoffman of New Jersey, died April 10 in Passaic, N. J., at the age of 58.

Mr. Knight began his first engineering work in 1897 as a draftsman, and after several years as draftsman and engineer for various construction and realty companies he became designing engineer on the water purification work at Toledo, Ohio. He was active in the design and construction of water purification plants at Manchester, Va., Alton, Ill., Valparaiso, Ind., and Lorain, Ohio, and for the Baltimore County Water & Light Co.

Then followed several years in consulting and construction practice, after which he entered into partnership with L. A. Quale to practice sanitary and hydraulic engineering in Chattanooga, Tenn.

During the war Mr. Knight was a captain of Company A, 16th Engineers, and adjutant to the chief engineer of the Second Division, organizing the water supply service for the American troops in France.

After the war Mr. Knight practiced in Passaic, N. J., later entering into partnership with W. G. Taylor. He was employed by the city of Passaic on local mill wastes, river pollution, and the Passaic Valley trunk sewer. He was for three years city engineer and executive officer of the board of public works of Paterson, N. J., and served as consulting engineer for the city of Newark in conducting a survey for the New Jersey Water Policy Commission.

Maryland Halts Tax Diversion To Avoid Federal Penalties

The Maryland legislature on April 5 passed a bill returning $3,300,000, which had been slated for diversion to balance the state budget, to the state highway program; $1,300,000 of this sum is already earmarked for specific road projects. This move by the state follows action of the federal government to penalize the state for tax diversion by deducting one-third from its federal-aid apportionment, as provided by authority of the Hayden-Cartwright act. (*ENR*, March 25, 1937, p. 458).

The state's action restored sufficient funds to its highway program to eliminate imposition of the diversion penalties.

On the same day, Governor Hoffman of New Jersey vetoed a bill which would have brought about the diversion of about $8,000,000 in highway tax funds.

SOCIETY CALENDAR

AMERICAN SOCIETY OF CIVIL ENGINEERS, spring meeting, San Antonio, Texas, April 21-24.

NATIONAL RIVERS AND HARBORS CONGRESS, annual convention, Washington, D. C., April 26-27.

NATIONAL LIME ASSOCIATION, annual convention, Chicago, Ill., May 11-12.

BUILDING OFFICIALS CONFERENCE OF AMERICA, national convention, Cleveland, Ohio, May 31-June 4.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Buffalo, N. Y., June 7-12.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, New York City, June 28-July 2.

AMERICAN WATER WORKS ASSOCIATION, MONTANA SECTION, Lewiston, Mont., April 19-23; FOUR STATES SECTION, Philadelphia, Pa., April 22-23; ILLINOIS SECTION, Springfield, Ill., April 29-30; PACIFIC NORTHWEST SECTION, Victoria, B.C., May 20-23.

ARKANSAS WATER WORKS CONFERENCE, annual conference, Fayetteville, Ark., April 12-14.

GREATER NEW YORK SAFETY COUNCIL, annual convention, New York City, April 13-15.

MICHIGAN ENGINEERING SOCIETY, annual meeting, Saginaw, Mich., April 15-17.

PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION, joint meeting with A.W.W.A., Four States Section, Philadelphia, Pa., April 22-23.

CALIFORNIA SEWAGE WORKS ASSOCIATION, spring conference, Stockton, Calif., April 23-24.

AMERICAN SOCIETY OF CIVIL ENGINEERS, METROPOLITAN CONFERENCE OF STUDENT CHAPTERS, annual spring conference, New York City, April 24.

AMERICAN GEOPHYSICAL UNION, SECTION OF HYDROLOGY, annual convention, Washington, D.C., April 29-30.

MARYLAND-DELAWARE WATER & SEWAGE ASSOCIATION, annual conference, Wilmington, Del., May 6-7.

NORTH CAROLINA INDUSTRIAL SAFETY CONFERENCE, Winston-Salem, N. C., May 20-21.

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, New York City, May 22.

LICENSE EXAMINATIONS

NEW YORK: Examinations for registration of professional engineers and land surveyors will be given by the New York State Board of Examiners July 6, 7, and 8 at Albany, Buffalo, New York, and Syracuse. It is expected that assignments to these examinations will be limited to candidates who filed their applications before Jan. 1, 1937.

Washington Highlights

By Paul Wooton

The Central Railroad of New Jersey has asked the Interstate Commerce Commission for permission to construct 1.87 miles of new line to serve the proposed port terminal to be constructed in Bayonne, N. J., with PWA funds.

During the first 18 months of its existence the Works Progress Administration, according to a Treasury report cited by WPA Administrator Harry L. Hopkins, expended $2,473,286,041, of which $2,104,291,452 or 85.1 per cent was for "personal services." The period covered ended on January 31, 1937. WPA administrative costs have averaged less than 4 per cent according to Mr. Hopkins.

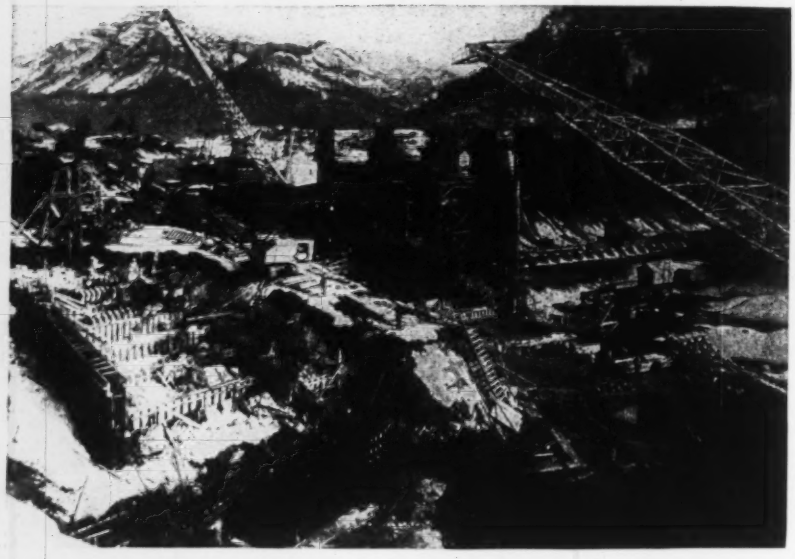
Full agreement with President Roosevelt's proposal to shift the emphasis in government spending from durable to consumer goods has been expressed by PWA Administrator Harold L. Ickes. Nevertheless Administrator Ickes made it clear that he considers it advisable to continue the life of PWA as a planning agency to prepare for the possibility of another depression. He stated that the staff of PWA will gradually be cut down as its work approaches completion, pointing out that approximately $1,000,000,000 in public works projects are still in various stages of construction.

President Roosevelt has asked the Bureau of Reclamation to study construction costs of the proposed Possum Kingdom dam on the Brazos River in Texas. When first proposed, the Brazos River Conservation and Reclamation District estimated its cost at $3,100,000, and this amount was allotted by the Works Progress Administration with the provision that construction be supervised by the Corps of Engineers. Further investigation by the Army developed the fact that foundation conditions were more difficult than had been anticipated, and an increase in the allotment to $6,600,000 was requested. The need for this additional amount has been disputed by local interests, with the result that the Reclamation Bureau has been asked to prepare an independent estimate. It is considered possible that the project may be permanently transferred to the bureau.

Central Air Cooling Plant Installed in Washington

The first large installation of a central water cooling plant for air conditioning of separate buildings is under construction in Washington. A new power plant building will house refrigerating and water cooling equipment for air conditioning the Capitol, the Senate office building and the old and new House office building.

The 6,000 hp. plant will have a water cooling capacity of 8,000 gal. per minute to a temperature of 40 deg. F. The consulting engineers for the installation are Charles F. Leopold of Philadelphia and George A. Weschler of Washington, D. C. The York Ice Machinery Corp. of York, Pa., is building the machinery.



FISHWAYS FOR BONNEVILLE DAM

OVER $3,500,000 is being spent to provide channels through which salmon can pass Bonneville Dam on the Columbia River. This picture of the Washington end of the dam shows one of the fish locks under construction at the left of the spillway, and between the dam and the observer, the formwork for a long fish ladder that begins at the face of the dam, comes up the slope toward the observer, swings through a half circle in the foreground and continues upstream in a series of stepped pools clearly seen at the left. This part of the ladder ultimately will be continued up to the level of the dam pool.

Washington Highway Code

(*Continued from page* 568)

office until their terms expire, but have no authority unless appointed to the position of road engineer. In King county, for example, the present incumbent continues as county engineer, but his chief assistant was appointed road engineer and is in actual charge.

In the counties, disputes sometimes developed between the county commission and the engineer. Under the new code, "all duties that have been or shall be by law vested in the county engineer are assigned to the commissioners."

Counties must deposit all funds derived from the gas tax and from road district levies in a county road fund, not less than 50 per cent of which shall be spent for construction. They must call for bids on all equipment costing more than $500, if payment is to be made from this fund. Such bids must be publicly opened and the award made to the lowest and best bidder. In the presence of collusion or if an insufficient number of bids are received, the board may readvertise.

Day labor on primary highways is restricted to $10,000 per job. Both original estimates and final costs of day labor jobs costing more than $2500 must be advertised.

On county projects, $7500 is set as the limit for day labor jobs. At completion, the county must publish an "accurate statement of the true and complete cost."

No county may award a road contract if the total amount of the bid exceeds the estimate of the engineer by more than 10 per cent. Previously, the board had unlimited power.

An important provision requires contractors bidding on state highway projects to give evidence of their "financial ability and experience . . . in performing state highway, road, or other public work."

Counties are required to prepare plans, specifications, and estimates on each construction job costing more than $500 (excepting emergencies), whether the work is to be done by contract or by day labor. The plans and specifications must be approved by the director of highways.

Another requirement specifies that no oil "or other material" is allowed on county roads or private driveways if it will be tracked by vehicles onto cement concrete or asphaltic concrete state or county roads.

Section 54 of the state-aid highway act reads: "No monies shall be paid by state auditor from funds accruing to the credit of any county in the motor vehicle fund for deposit in the county road fund of any county except on vouchers for reimbursement of proper county road expenditures theretofore made and properly supported and approved by the director of highways. All road funds must be deposited in and expended from the county road fund . . . and no county is entitled to receive any funds from the motor vehicle fund unless and until the board of county commissioners shall have satisfied the director of highways of compliance with the provisions of this section."

County commissioners must make such reports of expenditures as may be required by the director of highways, on prescribed forms. If reports are not submitted by any county, further funds shall be withheld.

The code further provides that a city's share of the motor vehicle fund may be used for construction and maintenance of streets designated as forming a part of a primary state highway. Maintenance is limited to work required to keep the street in a condition reasonably consistent with original construction. Funds may be used on other streets only with permission of the director of highways.

TVA Budget Asks $43,000,000

The three directors of the TVA appeared before the House Appropriations Committee April 12 in the customary justification hearings to explain the need for an expenditure of $54,291,000 in carrying on the program of the authority through the fiscal year beginning July 1, 1937.

As approved by the Bureau of the Budget, TVA needs will be met by an appropriation of $43,000,000. A carry-over from the fiscal year 1936-37 of $6,883,000 plus estimated receipts of $5,291,000 will, in connection with the appropriation, provide for the budgeted expenditures of the authority and leave $883,000 to be carried over to the fiscal year 1938-39.

Construction activities at Hiwasse Dam will be continued at about the same rate, and the rate of progress will be accelerated at Guntersville and Chickamauga. Provision is made for continuing investigations at Gilbertsville, Watts Bar, and Coulter Shoals expenditures will decrease at Norris, Wheeler, and Pickwick Landing.

Mosquito Workers Warn Of Malaria Increase

A warning was sounded that malaria was on the increase in this country as mosquito fighters from 14 states and 3 departments of the federal government gathered in Atlantic City on March 17-19 at the twenty-fourth annual meeting of the New Jersey Mosquito Extermination Association. Studies of the U. S. Public Health Service indicate that malaria-infected regions have almost doubled in area within the last five years. This was attributed to the creation of a large number of mosquito breeding places by impounded water projects.

The symposium of 27 papers dealing with all phases of mosquito extermination, including a world-wide review of control activities, will soon be published in the proceedings of the association. Applications for copies should be addressed to Dr. T. J. Headlee, Rutgers University, New Brunswick, N. J., not later than May 10.

Markham Endorses Ship Canal

(*Continued from page* 568)

difference in unit costs, as well as the reduction in yardage resulting from a reduction in the board's 35-ft. depth to 33 ft. and its open-channel width from 600 to 400 ft. along nearly 100 miles of the canal, reduced the board's estimate of $198,600,000 for excavation to the general's total of $146,950,000, accounting for a large part of the difference in total cost estimates.

The character of the Ocala rock was also responsible for a difference of opinion in the cost of annual maintenance. The board estimate is $1,050,000 annually; Gen. Markham's is $470,000. The board anticipates difficulty with boulders too large for the dredge intakes; the general feels that the impact of the cutting head will be sufficient to shatter most of the boulders encountered in the maintenance operations.

Gen. Markham also discussed at considerable length the determination of minimum dimensions for the canal. He agreed with the rivers and harbors board that the minimum bottom width should be 400

ft., rather than the 250 ft. adopted by the revisory board. He disagreed, however, with the proposed minimum, in the open-water sections of the canal, of 600 ft. and reduced this to 400 ft. in making his own estimate. An important consideration in discussing widths is the character of the canal traffic: approximately 75 per cent will be tankers, of which a considerable proportion will be carrying gasoline. The hazard of collision under such circumstances was held to justify the abandonment of the 250-ft. minimum width.

In regard to depth, the general held that the 35-ft. minimum proposed by the rivers and harbors board is unnecessary at this time, inasmuch as tanker design is well standardized at a 28-ft. draft, and the 33-ft. depth would accommodate 95 per cent of the 1935 Gulf traffic.

Interest during construction was figured by the revisory board at 4 per cent; by the rivers and harbors board at 3.7 per cent; by Gen. Markham at 3 per cent during the six-year construction period and 3½ per cent thereafter. The general made no allowance for amortization, stating that he could see no justification for amortizing a permanent improvement that would be adequately maintained.

Questioned by the committee as to the effect upon his estimates of the possible use of relief labor, Gen. Markham answered that the additional cost resulting would depend entirely upon the severity of the restrictions imposed. To meet his estimates, he stated, would mean "straightforward, driving contract work and nothing else." The requirement that common labor be obtained from relief rolls might mean an additional cost of $10,000,000; if skilled labor had to be taken from relief rolls the cost would be increased more.

Ground water effects

Gen. Markham discussed briefly the questions that had arisen regarding possible effects of a sea-level canal upon groundwater levels and quality, and reiterated the statement in his written report that any such effects would not be "consequential or vitiative." The subject was considered much more exhaustively by a subsequent witness, Malcolm Pirnie, who had made a thorough study of the water question for the army engineers (*ENR*, Jan. 9, 1936, p. 59). Mr. Pirnie stated that the measureable effects on groundwater would be limited to a narrow zone, certainly not exceeding 15 mi. on each side of the canal, where a drop in groundwater levels might necessitate the deepening of some shallow wells. Nowhere else, in his opinion, would the effects of the canal be apparent.

Slee Joins Road Builders Staff

The American Road Builders Association has announced the appointment of W. C. Slee, of Baltimore, Md., as assistant engineer-director of the organization.

Mr. Slee is 38 years old. A graduate of the Drexel Institute in Philadelphia, he gained wide experience in his connections, as construction engineer, with several of the leading construction firms of Pennsylvania, operating in that state, Maryland, and West Virginia. He served as city engineer for three years at Hagerstown, Md., and was more recently connected with one of the larger road building materials companies.

Flood Damage to Ohio Roads Was Exaggerated

Statements that Ohio roads were damaged to the extent of $10,000,000 were made officially by the governor and state highway director shortly after the January floods in the Ohio River subsided. George B. Sowers, consulting engineer, Cleveland, has just reported that the flood damage to the state highway system did not exceed $406,000 and that the loss due to unusual rainfall of January did not exceed $185,000. With a staff of former county engineers, one of whom was a bridge engineer, 3,000 miles of the state highway system in southern Ohio was inspected. Mr. Sowers states that he had the fullest cooperation with the Highway Department and access to all of their reports on flood damage. In computing his estimates the Department figures were used as a basis.

One large item of the $10,000,000 estimate was $4,464,940 of damage to the federal-aid portion. Of this amount, Mr. Sowers found not more than $364,100 could be properly classed as flood damage and $106,600 as damage attributable to unusual rainfall. Almost $2,500,000 of the Federal aid damage program was new work rather than flood or rainfall damage.

In connection with this survey Mr. Sowers called attention to the fact that the estimated cost of highway relocation in the Muskingum Conservancy District has been raised from less than $4,000,000 as of June 1935 to almost $9,000,000 as of August, 1936, without there having been any change in the reservoir plans. The state's $4,000,000 appropriation has all been expended, though little more than one-third of the contemplated work has been completed. In his request of the state legislature for a 1-cent increase in the gasoline tax Governor Davey is including an item of $5,000,000 for this relocation work.

Construction Statistics Work Supported by League

Continuation of the construction statistics work carried on by the Commerce Department was urged by William Stanley Parker, general chairman of the Construction League, in representing the League before members of the Senate committee which is now considering the Commerce Department appropriation. The House committee eliminated the budget bureau's provision for this construction statistics activity, while increasing the appropriations for foreign commerce and domestic retail trade studies.

Formation of a construction economics section in the marketing research division of the Bureau of Foreign and Domestic Commerce, two years ago, constituted the first systematic activity of the federal government in the field of construction statistics. Scattered work on the subject had previously been done and in part is still continued. Some work on housing data was done by the Bureau of Standards prior to 1933 and later by the Federal Housing Administration and the Home Loan Bank Board; federal public-works data were compiled between 1931 and 1935 by the Federal Employment Stabilization Board; building permits and construction employment are partly covered by data regularly collected by the Department of Labor, while the Census Bureau compiled certain construction data in its 1929 and 1935 construction census. None of this work, however, deals with the construction industry as a whole or embraces all of the important basic statistics of construction, in the League's view.

Mr. Parker urged that a sufficient appropriation be made to enlarge the present statistical and economic analysis work of the construction economics section. The original recommendation of the budget bureau provided $300,000 for an industrial economics division, of which the construction economics section would form a part, but the House committee cut the appropriation to $125,000, and in addition specified an allocation that would prevent expansion of the construction economics work, for which at present only $12,000 is available.

Sabotage Suggested in Break In Platte Valley Siphon

Engineers investigating the break March 30 in the Paxton siphon of the North Platte River diversion canal stated that "We are now unable to state the cause of the failure beyond a reasonable doubt." The report stated that the break might have been caused by "sudden and material settlement of the soil supporting the north end of the most southerly section of the siphon, or by an unknown agency."

The second possibility suggested by the engineers bore out an earlier report of the board of directors of the Platte Valley Power and Irrigation District in which it was announced that a preliminary investigation of the break indicated that it "was brought about by some unnatural force that could well have been the unlawful and criminal act of some human agency."

A break which occurred in the siphon on Feb. 4 and had just been repaired at a cost of $20,000 was caused by ice pressure. At the time of the second break, no ice was present and no evidence was found of a leak or seepage.

The break damaged about 50 ft. of the concrete siphon and canal retaining wall, flooding farm land.

Vermont Engineers Hold Annual Meeting

Registration of engineers was the principal subject of discussion and the topic of the address of President Earle R. Welch at the 25th annual meeting of the Vermont Society of Engineers, held March 31 in Burlington, Vt. President Welch stated that a registration bill has been sponsored by the society at the present session of the legislature and there is confidence that it will be passed. A provision has been incorporated into the bill whereby the board can enter into agreement for reciprocal registration with other states having equal qualification requirements and standards.

R. S. Currier was elected president and A. D. Bishop first vice-president. L. B. Puffer becomes second vice-president, L. T. Hayward secretary, and A. J. Runnals treasurer. J. B. Johnson will serve as director for three years.

Obituary

E. A. SPETMAN, 51, formerly city engineer of Council Bluffs, Iowa, died recently in Oklahoma. Since 1934, Mr. Spetman has been resident engineer for PWA at Des Moines, Iowa.

H. B. ALLEN SICKEL, resident engineer for the Alum Fork Dam on the Little Rock, Ark., water supply project, died at Little Rock on March 31. Mr. Sickel had specialized for many years in water supply projects in the rice district around Stuttgart.

A. R. CAMPBELL, 84, civil engineer and builder, died March 31 in Bellingham, Wash. He was formerly city engineer of Bellingham and had served as county engineer for Whatcom county, Wash. He retired about five years ago.

W. C. STURDEVANT, 60, civil engineer, died March 28 at Chehalis, Wash. A graduate of the University of Nebraska, Mr. Sturdevant had served as city engineer at Fayette, Idaho, and Chehalis. He had been Washington state maintenance engineer and deputy engineer for Lewis county, Wash.

SAMUEL A. ROBERTSON, 55, a contractor of Gulfport, Miss., died there April 3. Mr. Robertson, who was formerly connected with the List Construction Co. of St. Louis, had recently formed the Robertson Construction Co. which is now engaged on construction in the harbor of Gulfport.

HORACE F. GOODWIN, an engineer in the New Hampshire highway department, died recently in Candia, N. H. Mr. Goodwin was a graduate of the Massachusetts Institute of Technology, and was for many years on the engineering staff of the Truss-Con Steel Corp. of Boston.

LOUIS P. DE LUZE, a retired civil engineer formerly on the staff of the New York City Transit Commission, died in New York April 6 at the age of 78. Mr. de Luze, a graduate in 1879 of the Columbia School of Mines, was for some years a partner of the late Col. Robert T. Emmet, and, as assistant engineer, worked on the construction of the New York subway system.

HARRY R. TALCOTT, assistant to the chief engineer of the Baltimore & Ohio R. R., died April 6 in Washington, D. C., aged 75. Mr. Talcott entered the service of the Chesapeake & Ohio R. R. in 1879 in the engineering department, and served for the next twenty years in the engineering departments of various railroads, government agencies, and construction companies. In 1894 he became chief engineer of the Seattle, Lake Shore & Eastern Ry., and three years later chief engineer of the Seattle & International Ry., at the same time holding engineering positions in other railway companies in the same locality. Nine years later, Mr. Talcott became assistant engineer in charge of survey and location for the Baltimore & Ohio Railway, being advanced to the rank of assistant chief engineer in 1907, which position he had held since.

LARGER AWARDS FOR THE WEEK

Packing plant, Independent Packing Company, St. Louis, Mo.	$
Factory, Chevrolet Motor Company, Tonawanda, N. Y.	
Cracking plant, Bradford Oil Refining Company, Foster Brook, Pa.	
Residential development, Housing Products, Inc., Rochester N. Y.	
Residential development, D. Pelhemus, Albany, N. Y.	
Residential development, F. J. Walsh and Co., of Chicago, in Hammond, Ind.	
Apartment, One Thousand One Jerome Avenue Corp., New York, N. Y.	
Store building, J. B. Van Sciver Company, Allentown, Pa.	
Supply building, headhouse and warehouse, Army Air Corps Supply Depot, Sacramento, Calif.	
Hospital, Veteran's Bureau, Kecoughtan, Va.	
School, Public School No. 152, Woodside, N. Y.	
Post office, Waterloo, Ia.	
Paving various streets, Chicago, Ill.	1,
Highways, Ohio	
Highways, Oklahoma	
Regulating gates and spillways at Bartlett and Mormon Flat Dams, Salt River Project and Parker Dam, Ariz. and Calif.	
Airport, Stratford, Conn.	
Hydro-electric power development, Danville, Va.	1,00
Pipe line, 65,000 tons 18 in. to 24 in. steel pipe for 285 mile line between Texas and Detroit, Mich., Panhandle Eastern Pipe Line Co. of New York and St. Louis, Mo., in Tex. and Mich.	4,500,000

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
Apr., 1937	230.25	110.64	Mar., 1937	147	64
Mar., 1937	225.25	108.18	Feb., 1937	181	79
Apr., 1936	202.20	97.20	Mar., 1936	160	70
1936 (Av.)	206.46	99.24	1936 (Av.)	185	81
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50

CONTRACTS
(Thousands of Dollars)

	Weekly Average Apr. 1936	Prev. 4 Weeks	Week Apr. 15 1937
Fed. Government	$1,386	$3,972	$4,270
State and Municipal	24,965	16,047	18,149
Total public	$26,351	$20,019	$22,419
Total private	12,741	22,239	24,508
Week's total	**$39,092**	**$42,258**	**$46,927**

Cumulative to date:
1936 (16 weeks).....$729,296,000
1937 (15 weeks).....$651,445,000

Note: *Engineering News-Record* reports waterworks and earthwork, reclamation or waterways projects of $15,000 and over in size; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000 and over. The figures above represent the volume of contracts and large force account projects throughout the U. S. that are of these minimum sizes or over.

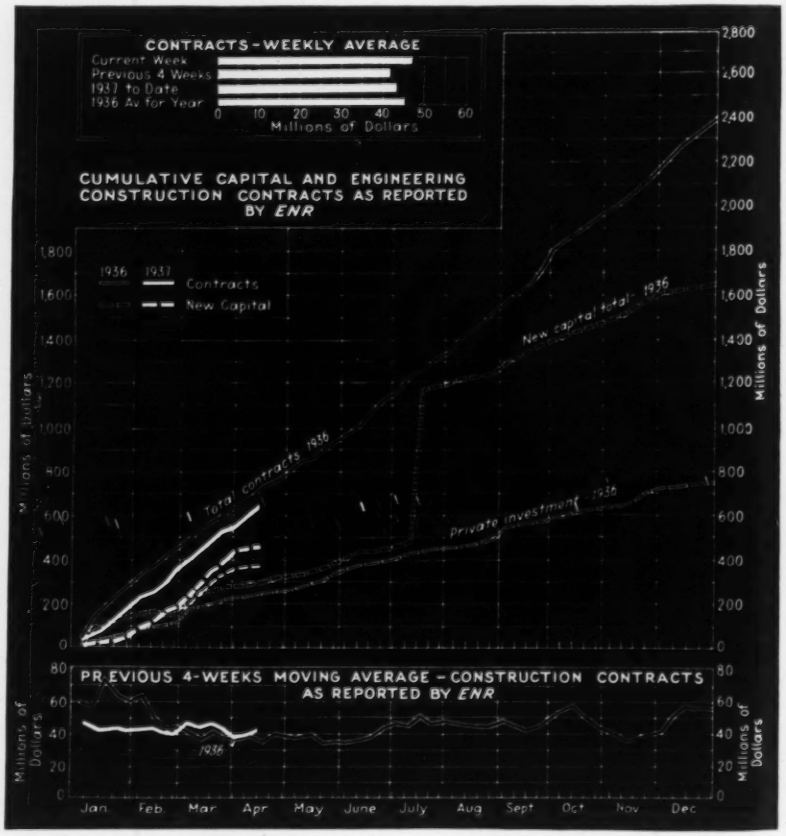
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1937	Week Apr. 15	Cumulative
Private investment	**$8,830**	**$387,732†**
State and municipal bonds	3,163	168,660†
Corporate securities	5,667	219,072
Federal financing	.....	**$75,701**
PWA non-federal Projects	.....	46,569
Federal projects	.....	.....
R.F.C. Loan	.....	29,132
Total non-federal	**$8,830**	**$463,433**
Total	**$8,830**	**$463,433**

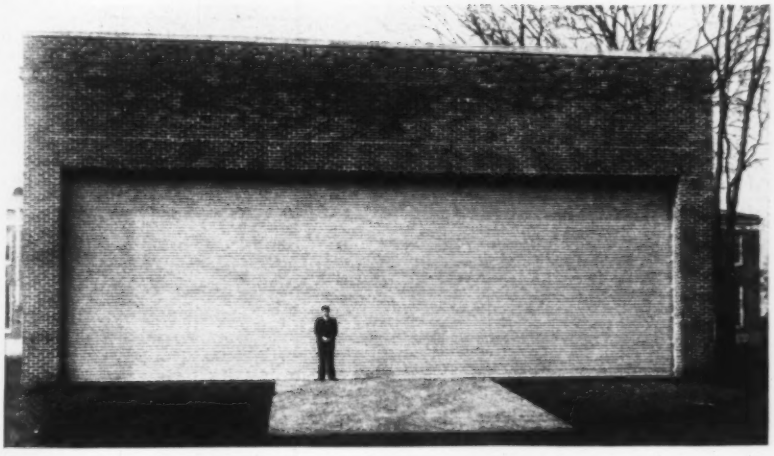
Cumulative to date:
1936 (16 weeks).....$322,349,000
1937 (15 weeks).....$463,433,000

Note: These figures include private bonds and stocks sold for new construction purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.

† Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.

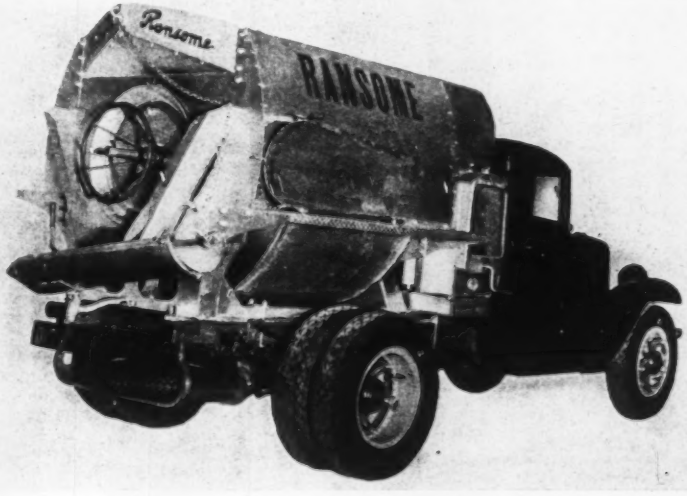

CONTRACTS - WEEKLY AVERAGE
Current Week
Previous 4 Weeks
1937 to Date
1936 Av. for Year
0 10 20 30 40 50 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1936 1937
Contracts
New Capital
New capital total 1936
Total contracts 1936
Private investment 1936
Millions of Dollars
PREVIOUS 4-WEEKS MOVING AVERAGE - CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1936
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Construction Equipment and Materials



BIG DOOR FOR LABORATORY

THIS steel rolling door, 46 ft. 8 in. wide, by 16 ft. 1 in. high, installed in the aeronautical laboratory at the University of Alabama, is stated by its makers, the Kinnear Manufacturing Co., Columbus, Ohio, to be one of the largest of its type ever built. The 10-ton door is raised and lowered by means of hand chains operating through reduction gearing with a ratio of 80 to 1.



Versatility is Feature Of Ditch Dredger

The newest dredger of the Ruth Dredger Mfg. Corp., 5980 So. Boyle Ave., Los Angeles, Calif., the Model H-U, which is intended for excavating and cleaning irrigation and drainage ditches, for levee building, and for highway construction and maintenance, is said to be extremely versatile in its operation. A fully adjustable bucket elevator, operable from either side, and a telescoping frame which permits the dredger either to run along a roadway on one side of the ditch or to straddle a ditch with narrow banks, permits a great variety of arrangements for different types of excavation work.

The dredger has a capacity of 120 cu.yd. per hr., and at a 1 to 1 slope will excavate or clean ditches from ground level to a depth of 9 ft. 6 in. where bottom is round or 7 ft. where bottom is flat. It is stated that it will clean the bottom and both banks of round bottom ditches to a depth of 5 ft. in one operation. The distance between tracks is adjustable to a span of 32 ft., and the machine will run along one bank if a roadway of 6 ft. 7½ in. is available. The extension track unit may be run at an angle with respect to the main track and steered around structures or along the regular ditch bank.

Forward traction speeds while working range from 4 to 88 ft. per minute, and reverse speeds from 5 to 20 ft. per minute. The elevator digging speed has a range of 26 to 48 buckets per minute.

It is stated that the average cost of operating the Model H-U Ruth dredger, including operator, gas and oil, and maintenance, is about $9.25 per day, resulting in an excavating cost of from one to 1½ cents per cubic yard, and a ditch cleaning cost of about $8.85 per mile.

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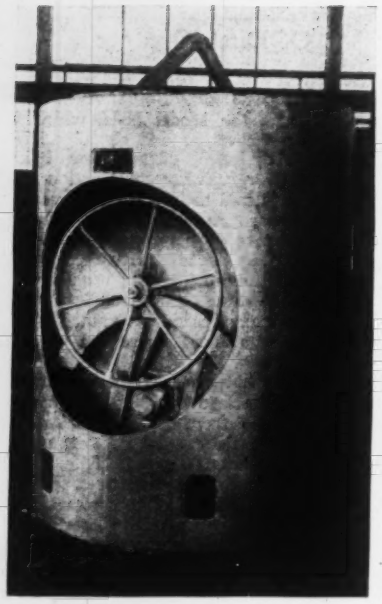
Ransome Truck Mixers

This Ransome truck mixer is one of the new line, embracing 1, 1½, 2, 3, 4, and 5 yd. sizes, manufactured by the Ransome Concrete Machinery Co., Dunellen, N. J. The shell of the three point mounted drum, the mixing blade, the charging door, and the discharge door, are made of high tensile steel of the manganese type with mixing blades designed for non-clogging.

The power unit, which is entirely independent of the truck motor, is mounted crosswise on the frame end and is equipped with right angle gear reduction, all gears fully enclosed and running in oil. Four drum-speeds are furnished, two forward and two reverse, and an automatic brake is applied automatically whenever the engine clutch is out.

The frame is an electrically welded unit with a heavy end section and flexible side sills to allow for slight weaving of the truck chassis.

Two water reservoirs are mounted above the engine, one the main water supply and the other for washout of the drum. A calibrated gage glass and valve are furnished for each reservoir, and a calibrated dial on the main reservoir measures the exact amount of water required for each batch. Water valves are of the hand wheel type to prevent accidental opening.



BUCKET BUILT FOR CLOSE QUARTERS

A new all-welded cylindrical concrete bucket is said by its makers, the Dravo Corp., Pittsburgh, Pa., to be particularly designed for convenience in operation in close forms and for handling low slump concrete. The bottom-dump controllable bucket is made in 2-, 3- and 4-yd. capacities. It has no projecting levers and is operated entirely by a hand wheel set into the outer shell of the bucket, or by two wheels in the 4-yd. size. The bucket is self closing, and it is stated that it can be closed readily when only part of the concrete has been poured. The bucket illustrated is the 3-yd. size.

Compound Permits Painting On Wet Surfaces

Wet-X-Hale is a new compound, particularly recommended by the manufacturer for iron and steel structures, which when mixed with paints, lacquers and varnishes, permits their application directly onto wet surfaces. This moisture proofing and rust proofing compound is said to deposit a paint film firmly on the surface. The product, which has been used in Germany for the past two years, is being introduced into this country by the Wet-X-Hale Paint-Compound Co., 572 Greenwich St., New York City.

Paint mixed with this compound may be applied with a brush to wet-from-rain surfaces or sprayed onto dewey-moist surfaces. The compound in the paint reacts upon the water, absorbing it, and then separates from the paint and forces itself, with the absorbed water, through the paint to the top of the paint film, where the entire water-laden compound decomposes and evaporates. The paint film is then left on the surface in its original state.

The compound is added to paint in proportions of five parts of compound to 95 parts of paint; use of the compound is said to increase the cost of paint about 95 cents a gallon.

Cleveland Trencher Company Builds New Ditcher

The new Model 110 Cleveland ditcher described in *ENR* Mar. 25, 1937, p. 465, was incorrectly stated to be a product of the Cleveland Tractor Co. The ditcher is manufactured by the Cleveland Trencher Co., Cleveland Ohio.

The new ditcher, especially designed for pipeline work, cuts a trench 10½ to 23 in. wide to depths up to 5½ ft. Digging speeds range from 1½ in. to 33 ft. per min., and the maximum road speed of the 6 ton machine is 3 miles per hour.

Wiley Resumes Manufacture Of Concrete Buckets

The Wiley Equipment Co., Lancaster, Pa., has resumed manufacture and sale of the original Wiley controllable bottom-dump concrete bucket. For the past five years the Blaw-Knox Co., of Pittsburgh, have been manufacturing and distributing the bucket under a royalty agreement with the Wiley company.

The essential dumping arrangement of the bucket has not been changed. The openings in the outside shells have been enlarged to give a better view of the case and the form, and welding has been substituted for 90 per cent of the riveting. Also, the top band has been placed on the inside of the shell to prevent its catching on forms.

Hydraulic Vibrator

The new Jackson Hydro-Spade manufactured by the Electric Tamper & Equipment Co., Ludington, Mich., consists of a vibrating element driven by a compact hydraulic turbine, enclosed in the vibrator shell, which is in turn driven by continuously circulating light lubricating oil, the necessary pressure being supplied by a small geared pump driven by a 3½-hp. air-cooled gasoline engine having a hand starter.

Special hose equipment has been developed for this tool, with oil-proof synthetic lining and a covering of tire-tread rubber. The pressure feed hose operates inside the flexible handle hose which is also the vacuum return line.

The engine unit, which is mounted on a removable pneumatic wheel, can also be used, after removing the vibrator, to drive a grinder or drill.

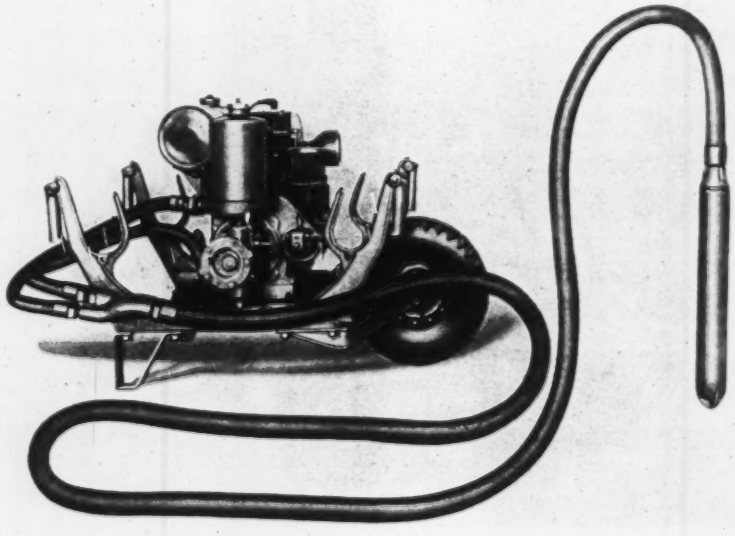
Prize Competition Announced In Use of Brick and Tile

Three competitions in the architectural and structural use of brick and clay tile which are open to engineers, architects, contractors, and realtors have been announced by the Structural Clay Products Institute, Inc.

One competition calls for sketches or photographs of decorative or structural details of clay masonry for any type of building or ground improvement. Separate prizes are offered for structural and architectural treatments; first prize in each class is $200; second prize, $100; third prize, $50, and ten honorable mention awards of $10 each.

Another competition, open to architects and draftsmen, calls for drawings of small houses built of structural clay masonry, brick, or clay tile. Two first prizes of $500 are offered, one for houses of five rooms or less, and one for houses of 5 to 7 rooms. A third competition calls for photographs and plans of small houses actually built since 1928. Two first prizes of $250 are offered in this competition.

The Structural Clay Products Institute, Inc. is a nationwide group of manufacturers of burned clay products recently organized to carry on the work of the American Face Brick Association, the Structural Clay Tile Association, and other associations of the burned clay industry. This competition is the first step in a broad promotional campaign. Further information about the contest may be obtained from the Institute at 1427 Eye St. N. W., Washington, D. C.



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